CANADIAN SEED GROWERS ASSOCIATION

REPORT

OF

SECOND ANNUAL MEETING

HELD AT

OTTAWA, June 27th, 28th and 29th, 1905

OTTAWA
GOVERNMENT PRINTING BUREAU
1905

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OTTAWA
GOVERNMENT PRINTING BUREAU
1905

CANADIAN SEED GROWERS' ASSOCIATION.

HEAD OFFICE: 138 QUEEN ST., OTTAWA, ONT.

Officers 1905-1906.

President.—Jas. W. Robertson, C.M.G.

Vice-presidents.—Prof. C. A. Zavitz, Guelph, Ont.; Messrs. G. A. Gigault, Deputy Minister of Agriculture, Quebec; John Mooney, Valley River, Man.

Secretary and Treasurer.—L. H. Newman, B.S.A., 138 Queen street, Ottawa, Ont.

Executive Council.—Prof. C. A. Zavitz, Guelph, Ont.; Messrs. W. L. Davidson, Bethel, Que.; G. A. Gigault, Deputy Minister of Agriculture, Quebec; W. L. Smith, Toronto, Ont.; L. S. Klinck, Ste. Anne de Bellevue, Que.

Directors.—Prof. C. A. Zavitz; Messrs. Thos. A. Peters, Fredericton, N.B.; G. A. Gigault, Quebec; Thos. H. Woolford, Cardston, Alta.; Hugh W. Gibson, Wolseley, Assa.; W. L. Davidson, Bethel, Que.; Morris Middleton, Vernon, B.C.; Thos. S. Waugh, North Bedeque, P.E.I.; J. O. Duke, Olinda, Ont.; John Mooney, Valley River, Man.; M. Cumming, Truro, N.S.; Geo. Harcourt, Regina, N.W.T.; J. W. Wheaton, Toronto, Ont.; W. L. Smith, Toronto, Ont.; Geo. Batho, Winnipeg, Man.; W. J. Black, Winnipeg, Man.; Wm. Thompson, London, Ont.; John Readey, Charlottetown, P.E.I.; L. S. Klinck, Ste. Anne de Bellevue, Que., and Donald Innes, Tobique River, N.B.

Auditors.—L. S. Klinck, Ste. Anne de Bellevue, Que., Accountant, Department of Agriculture, Ottawa, Ont.

Number of operating members, 1904.

Blank record forms for 1904 were issued to all of the members, and the reports that were made and returned show that 88 of them provided a special seed plot last year, from which they selected by hand seed for the seed plot of the present year.

The number of members from whom satisfactory reports were received is as follows:—

Prince Edward Island	9
Nova Scotia	10
New Brunswick	9
Quebec	18
Ontario	25
Manitoba	7
North-west Territories	10
British Columbia	0

LIST OF OPERATING MEMBERS.

The following list gives the names and addresses of the members from whom satisfactory reports were received for 1904, together with the kinds and varieties of crops with which they are operating, and the number of consecutive years which the seed has been selected.

WHEAT.

Ontario.

Davidson, Herbert, Nelson; Early Red Clawson, 2 years.
Fleming, David, Ivanhoe; White Fife, 5 years.
Gies, C. R., Heidelberg; Dawson's Golden Chaff, 4 years.
McKay, Robert, Maxville; Red Fife, 4 years.
Patterson, Robt. H., Northcote; Red Fife, 4 years.
Stevenson, N., Avonbank; Dawson's Golden Chaff, 5 years.
Murray, W., Avening; Garfield, 5 years.

Quebec.

Champoux, Ephrem, Ste. Gertrude; Fife, 5 years.
Coulombe, J. Bte., St. Jérôme; Red Fife, 5 years.
Goudreault, Abraham, Les Eboulements, Unknown, 5 years.
Levasseur, Jérémie, Tessierville; Campbell's W. Chaff, 5 years.
Perron, Joseph, Les Eboulements; Perron, 16 years.
Davidson, W. L., Bethel; White Fife, 1 year.
Davidson, W. L., Bethel; Red Fife, 5 years.

Prince Edward Island.

Arseneault, Elie E., Urbainville; White Chaff, 2 years.
Macmillan, Gordon, New Haven; White Fife, 5 years.
Waugh, Thos. S., North Bedeque; White Russian, 5 years.
Wigginton, T. J., Bridgetown; White Russian, 5 years.

Nova Scotia.

Mackay, Robert, Millsville; Red Fife, 4 years.
North, Amos B., North Corner, White Russian; 2 years.
Treen, Jacob W., Blue Sea Corner; White Russian; 4 years.

New Brunswick.

Cormier, B. H., Elm Tree; White Russian, 5 years.
Crewdson, John, Burden; Red Fife, 5 years.
Godin, Peter F., Elm Tree; Preston.
Innes, Donald, Tobique River; White Fife, 5 years.
Lagacy, Aimé, Green Point; Red Fife, 3 years.

North-west Territories.

Coles, F., Moffet; Preston, 1 year.
Dash, F. J., Hillisden; Red Fife, 4 years.
Gibson, H., Wolseley; Red Fife, 1 year.
Kirkham, F. & Sons, Saltcoats; White Fife, 5 years.
McKell, R., Regina; Red Fife, 5 years.
Nicholson, F., Perley.

Manitoba.

Boughen, Wm. Jas., Valley River; Huron, 3 years.
Lumb Bro., Cartwright; Red Fife, 1 year.
Thomson, Thos., Roden; Red Fife, 5 years.

OATS.

Ontario.

Boyce, Geo., Merivale; Banner, 1 year.
Dixon, Wm. L., Dromore; Banner, 4 years.
Dixon, Wm. L., Dromore, Golden Giant, 5 years.
Gillespie, A. P., Mansewood; Sensation, 1 year.
Hanmel, W. J., Parry Sd.; Pride of the North, 2 years.
Marriott, Jos., Hanbury; Banner, 2 years.
Prouse ,D., Goderich; Newmarket, 4 years.
Ramage, W., Thistle; 1 year.
Sullivan, Jas., Watford; Siberian, 1 year.
Wilson, Jno.; Marsville; Banner, 4 years.

Quebec.

Bélanger, Cyprien, Trois Pistoles; Tartar King, 4 years.
Davidson, W. L., Bethel; Banner, 4 years.
Déry, Joseph, Les Grands Déserts; Banner, 5 years.
Gagné, Joseph, L'Islet; Unknown, 4 years.
Gérin, Léon, Coaticook; Early Prize Cluster.
Johnson, Clarence D., Foster; Early Prize Cluster, 5 years.
Levasseur, Jérémie, Tessierville; Banner, 5 years.
Matthews, Gilbert, Lachute Mills; Banner, 5 years.
Parrott, Chas., St. Emile; 1 year.
Tremblay, Achille, Les Eboulements; Unknown, 5 years.
Trépanier, Henry, St. Stanislas; Banner, 2 years.

Prince Edward Island.

Creed, Richard, Albion, Lot 59; White Egyptian, 5 years.
Marchbank, James, New Annan; Black Tartarian, 5 years.
McKenna, Michael, Newton, Lot 26; Banner, 5 years.
Ritchie, Henry, Lot 10; Scotch Black, 4 years.
Waugh, Thos. S., North Bedeque; Gothland, 5 years.

Nova Scotia.

Brown, Peter G., Wallace Bay; Wallis, 5 years.
Campbell, John W., West Middle River.
Denton, Caswell H., Rossway; Banner, 4 years.
Long, John, Dalhousie East; Banner, 4 years.
Mackay, Robert, Millsville; Manitoba, 4 years.
Wright, Wm. O., Dalhousie East; American Beauty, 3 years.

New Brunswick.

Cripps, Henry, Jeffry; Improved Ligowa, 4 years.
Ferguson, John, Lower Queensbury; Early Triumph, 5 years.
Innes, Donald, Tobique River; Early Blossom, 5 years.
McNutt, Chas. H., Jeffries Corner; Early Blossom, 4 years.
McNutt, Chas. H., Jeffries Corner, Waverly, 2 years.

North-west Territories.

Dow, Geo., Gilbert Plains; Banner, 4 years.
Gibson, Hugh, Wolseley; 1 year.
Kirkham, F. & Sons, Saltcoats; Danish White, 5 years.
McKell, Robert, Regina; Banner, 5 years.

Manitoba.

Gendron, Médéric, Lorette; Unknown, 5 years.
Lundgren, Carl, Scandinavia.
Thomson, Thos., Roden; Banner, 4 years.
Mooney, John, Valley River; Banner, 2 years.

BARLEY.

Ontario.

Carmichael, Duncan, Jr., West Lorne; Mensury, 2 years.
Johnston, Jas., Lavender; Mandscheuri, 2 years.
Johnston, M., Brentwood; Mandscheuri, 1 year.
MacKey, Chas., Kinsall, 2 years.

Quebec.

Davidson, W. L., Bethel; Mensury, 1 year.
Davidson, W. L., Bethel; Duckbill, 1 year.
Gérin, Léon, Coaticook; Unknown.
Thébarge, Joseph, Richelieu Village; 2 rowed.

Nova Scotia.

Innes, Donald, Tobique River; 1 year.

INDIAN CORN.

Ontario.

Cochrane, A., Easton's Corners; White Flint, 1 year.
Duke, J. O., Olinda; Evergreen, 2 years.
Hubbs, Louis, Hillier; Evergreen, 2 years.
Hutton, G. H., Easton's Corners; Comptons.

Quebec.

Davidson, W. L., Bethel; Western Beauty, 2 years.

PEASE.

Ontario.

Nisbett, H. G., Lakehurst; McLean, 2 years.

PART I.

MINUTES OF SECOND ANNUAL MEETING OF THE CANADIAN SEED GROWERS' ASSOCIATION.

The chairman called the meeting at 2 p.m., June 27, 1905.

The secretary read the notice calling the meeting.

The Secretary.—The minutes of the last annual meeting of this Association were approved by the executive, and have been printed and generally distributed. Any person desiring to obtain a copy may do so.

Moved by Mr. F. Kirkham, seconded by Mr. Zavitz, that the minutes be taken as presented, and adopted.—Carried.

Communications were read from Mr. W. Thompson and Mr. S. A. Bedford, regretting their inability to be present at the meeting.

THE REPORT OF THE BOARD OF DIRECTORS FOR 1904-05.

The Secretary.—Your directors beg to report that since the last annual meeting the Association has made substantial progress. They beg to recommend that the Constitution of the Association be revised to conform to the needs of the Association as an organization not directly connected with the Department of Agriculture, and amended to read as follows, in sections 4, 5, 6, 7 and 10:—

Section 4.—The general officers of the Association shall consist of a president, a secretary-treasurer, and ten directors, which body shall have power to add ten other directors to its number.

Section 5.—The president and ten directors shall be elected each year at the annual meeting of the Association.

Section 6.—Three vice-presidents shall be elected by and from the completed board of directors.

Section 7.—The secretary-treasurer shall be appointed by the directors.

Section 10.—The Association may admit as members any persons resident in Canada who may choose to make seed growing a special branch of their farm operations, and who conform to the by-laws and regulations of the Association.

Further, your board recommends the receiving of names of applicants for membership and deferring action thereon until the applicant has carried on work of seed growing and seed selection, as required by the regulations of the Association, for at least one year.

Your directors also affirm the principle of granting special prizes for hand-selected seed and the product therefrom, at district exhibitions.

The Chairman.—The report deals wth at least three different subjects. It deals with the revision of the constitution, it deals with the question of delay in acting on the applications for membership, and it deals with the policy in respect to prizes. If we deal with each of those matters separately we should understand them better.

Moved by John A. Mooney, seconded by J. W. Wheaton, that the report of the board of directors be received, and considered seriatim.—Carried.

The Chairman.—The first part of the report is the recommendation of the directors with reference to the revision of the constitution. The duties assigned to the directors under the constitution include the making of recommendations regarding the revision of the by-laws and the regulations of the constitution as they may from time to time

see fit. Hitherto the work of the Association has been conducted as a part of the work of the Seed Branch of the Department of Agriculture. When such was the case, the Minister of Agriculture was quite agreeable to nominating or appointing the president, which he did last year. The minister thinks it desirable that the holding of office in voluntary associations by officers of the department should no longer continue, and I personally concur in the opinion that it is altogether undesirable in the main, that the officers of the department should be officers of associations having business to do with the department. It is not that these men are not capable and efficient as officers of the Association, but when the Association comes to the minister for financial help or legislation, he must refer the application to his officers for advice as to whether the application is one that should be granted in the public interest. If we think it necessary to ask for money from the department many of us think that it would not be good form, to say the least of it, for the secretary of the Association, who is at present also the seed commissioner, to appear as one of the deputation to interview the minister asking for money for the Association. That is the reason, therefore, for this decision; and I should like to make it clear that it is not from a lack of sympathy with the Association on the part of the minister, but because of the desirability of doing business in a proper way.

Moved by Prof. Zavitz, seconded by Donald Innes, that the constitution be revised as recommended by the board of directors, and that the executive council be directed to prepare the revised constitution for publication in the annual report of the proceedings.—Carried.

Moved by F. Kirkham, seconded by Donald Innes, that this Association concur in the recommendation of the board of directors to defer action in the election of applicants for membership for a period of at least one year, or until they have taken up the work of seed growing and seed selection according to the regulations of the Association.—Carried.

Moved by Prof. Zavitz, seconded by W. L. Davidson, that this Association approves the principle of giving prizes at seed exhibitions for seeds grown and selected according to the regulations of the Association.—Carried.

The annual report of the secretary of the Association was called for, and presented by the secretary.

REPORT OF SECRETARY.

G. H. Clark, Seed Commissioner, Department of Agriculture, Ottawa.

Mr. President and Gentlemen.—At the organization of this Association a year ago I presented, in the form of a report, some general information pertaining to that branch of educational work which had been carried on by the Department of Agriculture, with a view to encourage the production and use of agricultural seeds of superior quality, and to the progress that had been made with that work as shown by the records of the Macdonald-Robertson Seed Growers' Association. In my report for this year I have thought it well to present to you only a statement that will show in concise form what the members of the Association have accomplished since our last annual meeting, and what has been done by the Association to advance the interests of seed growers. I will leave that part of my report, which may treat more particularly with the work of inspecting the operations of members and the observations made therefrom, to the district sunperintendents, who have direct charge of the educational work of the seed branch in their respective districts, and who, from time to time, come into direct contact with the members on the farms where the seed is grown.

In order to more effectively carry out our plans of educational work, I divided the territory, and placed a trained man in direct charge of the work in each of four districts. Mr. F. W. Brodrick has charge of our work in the maritime district, with headquarters at Truro; Mr. Joseph Coté, who makes his headquarters at Ottawa, has been allotted the work in the province of Quebec; Mr. Leonard H. Newman has charge of

the work in the province of Ontario, with headquarters also at Ottawa, and Mr. James Murray commenced with this outside work in western Canada a year ago; his headquarters are at Winnipeg. I may say that I have found it necessary to subdivide the western district, and have secured Mr. W. C. McKillican to look after the work of the seed branch in the provinces of Alberta and British Columbia.

It has been our aim to solicit the interests of farmers who are favourably situated for growing seed of one or more kinds of crops in these various districts, with a view to get them to adopt a well defined system in the growing and selecting of seed, and to make seed growing a special industry in their farming operations. The system as outlined in the constitution of this Association is the one to which we have at all times, directed special attention. When visited by the district superintendents, farmers, to commence with, are urged to get the best obtainable variety and strain of seed, and to increase the supply of such seed in its state of purity and productiveness, by providing each year a small area of specially prepared land to use as a base of supply. Farmers are instructed that the aim in operating this special seed plot should not be to obtain a maximum yield per acre, but rather to provide the individual plants with favourable and uniform conditions for vigorous growth with a view to stimulate to a maximum yield per plant. Perhaps a small proportion of the farmers who are visited for the first time are convinced by the superintendents that it would be much to their advantage and a profitable undertaking as a special industry if they were to follow the work of seed growing and seed selection as outlined for members of the Association. This educational work, however, has been and will continue to be carried on with a view to induce farmers to make some effort to improve the quality of seed used on their farms, irrespective of whether they become members of this Association.

I am pleased to say that the records of the Association show a substantial increase in the number of farmers who have taken up the work and have signified their intention to carry it out in accordance with the regulations laid down at our last annual meeting. Perhaps the progress made has been greater in the province of Ontario than in any other district. In this province a large number of the corn growers have taken up the work of growing seed corn. Corn is the largest of our cereal grains, and the improvement that may be made in the corn plant in a short space of time is more apparent than with wheat or oats. Again, the good work that has been done by the corn breeders in the states of Illinois and Iowa has doubtless had a wholesome influence in stimulating our Canadian corn growers to take action along similar lines.

Wheat and oats are still the main crops with which members of the Association are operating. The average number of pounds of large heads of wheat selected by members is 33, and of oats, 48. We have issued during the past year 111 certificates of registration for 'Hand-selected' seed, 290 for 'Improved' seed and 187 for 'General crop' seed. No complaint has been received from any source regarding the quality of seed supplied by members, together with these certificates of registration.

System of Keeping Records and the Issuing of Certificates of Registration.

Association record forms are issued in duplicate each year to members and applicants for membership. Reports of the areas grown and yields from each of the three classes of seed are made out by the members on these record forms; one of them is returned to the secretary and the other is retained by the member for future reference.

Provision is made on the record forms so that members may apply for certificates of registration for seed produced, as shown by the report.

Before the data given in the reports are entered in the registration record book of the Association, the reports are referred to the district superintendents for evidence as to their correctness. The registration record book of the Association will show the history for an indefinite period, of each kind and variety of grain that may be grown by any member. We now have records of seed, of wheat and of oats that have been grown and selected by members for five consecutive years.

The records show the amount of Hand-selected seed taken each year; the size and the yield from the 'Hand-selected' seed plot, the size and yield from the 'Improved' seed plot, and give information regarding the kind of soil on which the seed was grown,

the crop which preceded on each of the seed plots, and notes regarding the conditions of the crops of the seed plots in respect to insect and fungus pests.

Certificates of registration for the 'Hand-selected' seed are printed on a tough paper of 'golden-rod' colour; for the 'Improved' seed the colour is blue, and for the 'General crop' seed a white paper is used. Each certificate for 'Hand-selected' seed represents ten pounds, which is plainly printed in bold type on the certificate. For the 'Improved' seed each certificate represents fifty pounds, and for the 'General crop' seed one hundred pounds. A member having a quantity of seed for sale may make application for a sufficient number of these certificates to meet his requirements. The system adopted in issuing these certificates is not dissimilar to that of issuing bank cheques. A statement of transfer is printed on the back of each certificate, which statement also includes a guarantee from the member that the seed thus supplied is the seed for which the certificate of registration was issued by the Association.

Grower's No..... No. H.....
Grower's Name.....
HAND-SELECTED SEED. 10 LBS.
Kind.....No.....
Date.....
Transferred to.....

Grower's No..... Coupon No. H.....

CANADIAN SEED GROWERS' ASSOCIATION.

Certificate of Registration.

HAND-SELECTED SEED. 10 Lbs.

Kind..... Variety.....

This is to certify that the ten pounds of seed, which this coupon represents, has been accepted for Registry in the records of the Association, and that the said seed is 'Hand-selected Registered Seed' of the.....year.

.....
Secretary.

OTTAWA,.....190 .

STATEMENT OF TRANSFER.

I hereby certify that the ten pounds of Hand-selected Registered Seed for which this coupon is issued, was produced by me in accordance with the rules for seed growing of the Canadian Seed Growers' Association, and was disposed of by me to—

Second owner..... Address.....

Dated at....., ...

.....190 .

.....
Grower's Signature.

Grower's No..... Coupon No. H....

CANADIAN SEED GROWERS' ASSOCIATION.

Statement of Transfer.

HAND-SELECTED SEED. 10 LBS.

To be filled out (before being detached from the Certificate of Registration) and forwarded to the Secretary, C. S. G. A.

Second Owner.....
Address.....
Province.....
Signed.....
Grower's Signature.

The utility of these certificates of registration for 'Improved' and 'General crop' seed has not been fully demonstrated. They are doubtless an assurance of the quality of the seed which they represent, and it may be deemed advisable to continue to issue the certificates of registration for those two classes of seed for some time to come; but it now seems clear to me that the time is not far distant when your secretary will appeal to you to lighten the burdens of his work by having the certificates of registration restricted to 'Hand-selected' seed only. The issue of an annual seed catalogue by the Association should do much to abridge the need for the issue of certificates of registration for 'Improved' and 'General crop' seed.

I need not refer to the publications of the Association that have been issued since our last annual meeting, or to the work that has been done by the Seed Branch in an endeavour to establish seed exhibitions. Those are matters with which you are already well acquainted. Now that the time has come when the workings of the Association are to be separated from our Department of Agriculture, I wish simply to refer to them as a work which you may deem it well to continue with as a means to further advance the interests of your members and other seed growers and farmers.

I regret that I have been unable to give as much time as I desired to the work of the Association. I have found that if we are to keep pace with the departmental work that continues to increase and crowd upon us, I will not have sufficient spare time to look after the work of the Association as it should and must be looked after by your secretary. In conclusion I wish to thank you one and all for your kindly support and co-operation that you have given me, as your secretary-treasurer, in my endeavour to place this Association on a good working basis. If I have succeeded in assisting towards that end, even though in a small measure, then I shall have something to look back to with a large measure of satisfaction.

The annual reports of the district superintendents were called for, and presented.

REPORT OF MARITIME SUPERINTENDENT.

By F. W. Brodrick, B.S.A.

Early in August of last year I was directed to visit as many as possible of the members of the Canadian Seed Growers' Association and others interested in the work of seed growing in the maritime provinces. The object of my visit was to inspect the work of seed improvement as carried on by these men, and to give instructions where needed as to means of improving and extending the work. The season last year was very unfavourable on account of the protracted drought during the months of July and August. As a result, farm crops were much smaller than they had been in years previous. Grain and root crops were very much under the average.

I was well satisfied with the manner in which the work of seed improvement is being carried on by the members of the Association. In nearly every case the plots were well looked after, and fairly free from noxious weeds and fungus diseases. Considerable care had been exercised in making the selections, and a marked improvement was shown in the resulting crops. In a few cases the presence of noxious weeds was noticed in the plots. In all cases the growers were informed of the undesirability of the presence of noxious weeds in first-class seed of any description. A quantity of smut was noticed in some of the plots of oats, and instructions were given as to the best means of eradicating it.

There are at present 25 members of the Association in the maritime provinces who have been operating seed plots for two or more years. There are also 32 applicants for membership in the Association, who will make their first selection this year. This makes a total of 57 in the maritime provinces.

I attended during the months of October and November a number of farmers' institute meetings, which were being carried on by the local Department of Agriculture in various parts of the province of New Brunswick. In the addresses which were given at these meetings, particular attention was paid to the subject of good seed and the work of seed improvement. These meetings were fairly well attended throughout, considerable interest was taken in the subject of good seed, and several applications for membership in the Association were received.

At the provincial seed fairs in New Brunswick and Nova Scotia I took charge of a competitive exhibit of seed grown by members of the Association in the maritime provinces. The exhibits were very creditable, and, I think, tended to stimulate a greater interest in our work.

I would recommend that a central seed exhibition for the maritime provinces be held yearly, where the members of this Association alone could compete. I think that it would be the means of making our work better known, and would create a greater interest in the subject of good seed. Spring seed fairs similar to those which have been held in the maritime provinces during the past couple of years are also an excellent means of stimulating a greater interest in seed improvement. I think it would be advantageous to hold short courses in grain judging and weed seed identification in connection with these fairs. The value of these short courses as a means of stimulating a greater interest in good seed was well illustrated at the seed fair that was held at Charlottetown this year.

One of the principal drawbacks to the advancement of the work of the Association is the general lack of interest which exists in regard to matters of this nature. Farmers, as a rule, are very busy during the summer season, and the extreme scarcity of farm labour which exists at the present time also causes people to hesitate before taking up any movement that will entail additional labour and expense.

Before closing, I shall quote a brief extract taken from a report received this year from one of my members in the province of Nova Scotia, Mr. John Long, of Dalhousie East. He says: 'The farmers in this locality are beginning to notice the beneficial results of improving seed by hand-selection. I think in a few years this method of improving seed will be generally adopted, and the product per acre greatly increased.'

REPORT OF QUEBEC SUPERINTENDENT.

By J. C. Coté.

Gentlemen,—I have the honour to submit to you my first annual report of the work done by the members of the Association in the district of Quebec, which is under my immediate supervision. During the year 1904, 23 members have successfully operated plots.

In 1905, 24 other farmers have requested permission to co-operate in the same work, so we have actually 47 progressive farmers who are trying to carry out the instructions which it has been my pleasure to give them.

As each seed grower is allowed to choose one or more crops for the purpose of practising selection, there are 55 plots in operation this season.

Sixteen are under wheat; 30 are under oats; 5 are under barley and 4 are under corn.

Since the organization of the Canadian Seed Growers' Association a considerable interest has developed in the farming community in the work it advocates. This may be attributed to several causes: First, the distribution of bulletins published by the department; second, the prominence given to the subject by the agricultural press, and, third, the practical lectures given in various counties of the province.

The need of such an association in the province of Quebec is evidenced by the intense desire manifested by the farmers to secure the seed which will produce the largest yield. In their endeavour to satisfy this legitimate desire the farmers have often been duped by unscrupulous agents who, representing themselves as connected with some experimental farm, furnished them with seed for which they demanded fabulous prices. Farmers bought this seed regardless of prices, only to experience the bitterest disappointment at finding that the promises of the sellers were not fulfilled. The yields were poor, and oftentimes the grain failed to come to sufficient maturity to be used as seed. The appearance on the scene of a responsible official upon whom they can rely, both for information and direction, has therefore filled a long felt want.

A membership of 47 in the whole province of Quebec is certainly not very large, but I consider that 47 conscientious experimenters can do more good than three times that number who would perform the work in a haphazard way. In selecting experimenters great care should be exercised that only good farmers and men who show enthusiasm to co-operate in the work be admitted as members. Undoubtedly there are a great many who would be willing and enthusiastic co-workers whom I have not yet had the pleasure of coming in contact with. Many of these I hope to meet during the present season, and thus the scope of the work will gradually become more extended.

The task of finding desirable co-workers would, to my mind, be greatly facilitated if the inspector of the district was allowed to choose a man in each county to whom he would entrust the care of selecting a few of the best and most conscientious farmers to carry on the good work of the Association.

The inspection of seed produced by members of the Association is, to my mind, one of the most important features of the superintendents' work. It brings the farmers in immediate contact with the officials of the department. The difficulties with which they have to contend are brought to the notice of the official inspecting the grain. The necessary means to be adopted are there, and then clearly pointed out, and the result is a strong impulse to the good work of the Association. During my visit of inspection I have often found it necessary to spend five or six hours in discussing agricultural problems with the farmers whose grain I was called upon to inspect: this proves to be of great educational value.

So far, since the formation of the Canadian Seed Growers' Association, very few data are at hand to prove how potent is the influence of selection in the improvement of crops, but one must remember that the Association has been in existence for one year only. It is needless to quote the results obtained by experimenters in the Macdonald competition, which have been already published. My visit of inspection, during the last season, has, however, given me ample proof of the benefit of selection practised according to the method outlined by the Association. In every case the appearance of the test plots was sufficient to amaze the interested farmers. The luxuriance of the growth was most apparent, and experimenters' reports show that there was a considerable increase in the yield and in the weight per bushel of the grain harvested. As an example of the general satisfaction experienced by the experimenters, permit me to read to you one or two letters received giving comments of the results obtained by the practice of the selection.

Trois Pistoles, June 20, 1905.

Mr. J. C. Coté,

Ottawa, Ont.

Dear Sir,—I am pleased to tell you that since I have been selecting my oats I get larger yields and heavier grain. I am more careful in keeping my land clean of noxious weeds.

My oats were a great success last year. I have sold some for one cent per pound more than that of my neighbours. I had demands not only in Quebec but also in Ontario.

Before closing, I must tell you that I have made up my mind to continue to select my grain. I remain,

Yours very truly,
(Signed) C. BELANGER.

LES EBOULEMENTS, June 15, 1905.

Mr. J. C. COTÉ,
Ottawa, Ont.

DEAR SIR,—I am pleased to tell you that since I have been selecting my grain I have increased the yield of my crops 30 per cent. I have to sow thinner, and the grain stools more and gives grain of better qualities.

The farmers in the district are not advanced in the improvement of their farm crops, and it would be of great benefit to them if they had a few lectures on this subject, when they would realize the benefits to be derived from selecting their seed.

Yours very truly,
JOSEPH PERRON.

REPORT OF ONTARIO SUPERINTENDENT.

By L. H. NEWMAN, B.S.A.

The work of the Canadian Seed Growers' Association in the province of Ontario, and of which, as officer of the department, I have had charge, is now fairly well established and quite widely distributed throughout the province as a whole. While the present membership is not large, yet almost every county is represented, and the growth of the Association since its first inception has been a gradual one. At the present time Ontario claims 27 members and 74 applicants. This is divided among growers of different crops as follows:—

11 seed wheat growers;
30 seed oat growers;
9 seed barley growers;
53 growers of seed corn;
2 growers of pease, and
2 potato growers.

Some of the growers enumerated above are growing more than one kind of crop, and hence are accounted for a like number of times.

GROWTH OF THE ASSOCIATION.

Although, as we have already noticed, the membership of the Association has grown considerably, yet this growth has not been at all commensurate with the importance of the work. For a satisfactory explanation of this condition we have not far to seek, and it seems quite apparent that the time has come when different tactics must be employed if we would have the Association attain to the position which its importance would warrant. Hitherto we have not been able to stimulate nearly the interest in the work which we would like simply because this Association has no organization within itself to facilitate this, and also because of the great amount of time required to visit the widely separated members. As a result, little time is left to get the farmers together throughout the various districts, and to bring the work before them intelligently. Thus far the farmers' institutes, seed fairs and such like institutions have been practically the only means of bringing this work before the public, apart from what has been done by the press. But such agencies as these, powerful though they may be, fail to reach the great mass of people who need assistance most. Furthermore, it is quite a different thing to tell a man what he should do than it is to induce him to do it, and it is evident that some radical means must be taken with this object in view.

RESULTS OF ORGANIZATION.

We notice that our largest membership is with seed corn. The reason for this is that a special effort has been made over a limited area to induce a number to take up the growing of seed of this great cereal. The particular section referred to comprises the counties of Essex, Kent and Elgin, in which section at present is to be found the majority of the total membership for the province, and it is only here that we have thus far been able to do any real organizing. The success attending this particular effort to get men together in order to bring the work before them and to induce them to take it up is ample proof of what might be done were we in a position to carry on the movement along this line. It is indeed unfortunate that there is no apparent compulsion to coërce men into taking up this work, which in many cases would be of decided benefit to them. While, therefore, it will in a large measure be a process of education, still with better arrangements we can do much to force the work to greater lengths.

INSPECTION OF WORK OF MEMBERS.

It has been our endeavour to thoroughly inspect the work that is being conducted by the various members, and to give them such information relative to the growing and handling of seeds as was at our command. By inspecting the work in this way and drawing the attention of the growers to certain facts, we have been enabled to stimulate a good deal of interest and enthusiasm in the work.

It is also quite apparent that if this work is going to be a success the great majority of members must be visited at least once a year, otherwise they will lose interest, and without interest there is no life nor activity, but a deadly monotony which saps the power of advancement.

EVIDENCE OF IMPROVEMENT.

That the crops operated with in the past have been greatly improved in yield and quality is amply attested to by those members who have been longest connected with the work, and we can accept no better evidence than that given by these men. The following letter is a fair sample of those received from some of the most progressive members:—

HEIDELBERG, June 15, 1905.

Mr. L. H. NEWMAN,
Ottawa, Ont.

DEAR SIR,—I find that no matter how well my soil is fertilized and cultivated the crop will be deficient and the quality of the grain poor unless high class seed is used High class seed, however, will not retain its original value if no selection is made. For the last five years I have paid special attention to the selecting of seed wheat, and I find that my extra labour has been well rewarded by the increase in yield and quality of the crop.

Yours truly,
(Signed) C. R. GIES.

POSSIBILITIES IN ONTARIO.

The scope open for an exceedingly useful work in connection with the developing of superior strains of the various crops is in this province practically unlimited. At the present time we find in many cases that variety names convey but little meaning. This is perhaps more noticeable in the case of corn than with many of the smaller cereals, since corn is much more liable to intermix one variety with another, and is more susceptible to climatic conditions as it requires a much longer period to reach maturity.

Furthermore, it seems evident that in this province there are many local differences of soil and climate requiring crops specially adapted to those conditions, and there is little doubt but that there are some varieties which are better adapted for growing on certain soils, and under certain conditions than are others. True, some varieties prove their adaptability over a wide range of country and to widely different climatic conditions, but it seems clear that the majority of our best varieties grown locally are 'best' only in limited areas depending upon the variability of these controlling conditions just referred to. Hence, where drought resistant varieties are required, the place to develop these is in that locality where such crops are to be grown, and this principle, being more or less applicable throughout, opens up an interesting and useful field of work. Furthermore, since some plants cannot adapt themselves to a change in conditions it does not follow that seed but recently home grown is always the best, as better bred seed may be brought in from other districts which may be better adapted to the conditions under which it is to be grown.

Many growers engaged in such commercial enterprises as the canning industry welcome with delight any means by which the special strains of corn they are growing may be specially grown and studied with a view to registering such under appropriate variety names.

Taking this province as a whole, we find that approximately 12,000,000 bushels of seed of the ordinary farm crops are annually required to sow the present acreage at the average rate of seeding. What per cent of this amount is first-class material would be difficult to estimate, but certain it is there is but a small per cent, if any, but what might be greatly improved. Over such an acreage the results, were but a small improvement effected, are obvious, and demand that no stone be left unturned in seeing to it that the plant home be not called upon to foster weaklings.

PUBLIC APPRECIATION OF GOOD SEED.

It is only to be expected that, with such work as the producing of high class seed under special regulations, many farmers will, for various reasons, find it impossible to carry on the work themselves. In many cases perhaps this is a fortunate coincidence, as such work requires men with special aptitude for it, and who can make of it a study and a business. Past experience goes to show that the public will gradually become educated to appreciate high class material, and as the demand increases. in like measure must the supply. In the past no special attempt has been made to disseminate this seed throughout the country. As a matter of fact, but a small surplus has been produced. In the future it seems to be the duty of this Association to encourage the judicious dissemination of this well bred seed as an important medium through which to educate the public at large as to the importance of using nothing but the best.

WAYS AND MEANS OF EXTENDING THE WORK.

As a body anxious to do the greatest good to the greatest number, the problem for our immediate consideration should therefore be how we are going to extend the work and have its influence felt by those who most need it. True, the work will grow: its merits demand it. But time is money, and it is evident that the time has come when more aggressive measures should be adopted to make this Association a stronger and a more useful one. Furthermore, the organization should now be sufficiently strong to stand alone, apart from departmental control and free from political controversy. Given a substantial grant and managed and directed by a competent person outside of the department, and who would act according to the advice of the directors and executive body, much greater freedom should result and much more real good be accomplished not only throughout Ontario but throughout the Dominion. If the work is to succeed we must have the co-operation of the leading agriculturists throughout the various districts. No one man can hope to reach the people in this province, or in any other district of any considerable size, without some special arrangement to this

end. It has been suggested that no district associations or clubs be formed until the membership will have grown sufficiently large to warrant it. When we consider, however, the probability of the wide separation of the members, even though the membership be very much increased, it is easy to see the difficulty even then of organizing locally. Hitherto we have been quite optimistic regarding the growth of the work. It is perhaps well to be optimistic when such optimism is not born of inexperience, but during the past few months ample opportunity has been afforded us to observe the extent to which the work would grow if left to move along the old channels. The plan, therefore, that we would suggest is that those agriculturists before referred to act as representatives for the Association in their respective localities. Such men might be encouraged to secure competent members in their district, receiving a certain specified remuneration for each new member who takes up the work and gives a satisfactory report after his first year's endeavour. These gentlemen should not expect any special reward for their services apart from that to which they are entitled for certain work which the Association might authorize them to perform. Such men should each form in his respective district a nucleus about which the work of the organization should extend and grow to larger proportions. These men might also in time be utilized to act as local inspectors, and could thus examine the growing crops in their district at an opportune time, and report to the superintendent, who in turn would be much better fitted to get the people together at local points and bring the work before them in a way not to be hoped for under present arrangements. At the present time the members are too far separated to have any such union, and thus the co-operation of ideas, which in this work should be of prime importance and conducive of much good, is rendered impossible. In this Association, therefore, as in many walks of life, 'unity' should be the watchword.

District representatives, possessing much enthusiasm and intelligence as well as the highest respect of their neighbours, should be a source of great strength to the Association, and should be invaluable to the community. We find that in the little country of Denmark the country is divided into parishes, each having its district association, and all associations working together harmoniously as a part of the whole. It is to be hoped that this idea will prevail in connection with the Canadian Seed Growers' Association, and that all connected with it combine for greater strength.

The functions of local organizations or clubs might be enumerated as follows:—

1. That valuable information might be compiled within themselves.
2. That suitable methods might be followed for certain districts.
3. That the interests of the members residing in the district might be better looked after.
4. That the holding of judging competitions and seed fairs might be facilitated.
5. That competitions between districts might be conducted, and a stimulus thereby afforded to gain the highest level. Districts in this way should be brought into closer touch with each other, and the dissemination of useful information greatly encouraged.
6. That the various districts might be brought into closer touch with the work of our experiment stations by the carrying of information of great value from these institutions.
7. That through this same medium the needs of the people might be more definitely ascertained, and, where necessary, brought under the notice of these same experiment stations.

By means of such a system as has been outlined the work of the Association should advance rapidly, and become of much greater service to the great mass of the people for whom it is intended. When the mind of the people is once opened up to the hope of improvement they will possess the soul of progress. It is therefore our duty as an Association to do all in our power to bring the organization to the highest degree of perfection, as it is one which is contributing directly and materially to the great national wealth of the country.

REPORT OF WESTERN SUPERINTENDENT (MANITOBA, NORTH-WEST TERRITORIES AND BRITISH COLUMBIA).

By Jas. Murray, B.S.A.

As an officer of the Department of Agriculture superintending the work of the Seed Branch in western Canada, I have been brought, during the last year, into close touch with the work of the members of this Association. In all parts of the country, by meeting men interested in the production of a good class of seed, I have made it a point to acquaint them with the work of the Canadian Seed Growers' Association, and in consequence have been instrumental in adding somewhat to its membership. The present membership in Manitoba, North-west Territories and British Columbia is sixteen, and in addition there are thirty applicants; this, however, is still very small, considering the extent of country served.

The work of such an association is met in the west with difficulties that do not enter into its operations in other districts. The primary object of the work of the Association is to effect an improvement in the quality of seed, and the work carried on by the Seed Branch has been most useful in stirring up a sentiment in favour of such improvement. In the dissemination of information relative to the quality of seed all work must needs start at the bottom, particularly where the system is all too prevalent of sowing cheap seed and selling wheat or oats that will grade better. The first step then, in popularizing the work of the Association, must needs be to show how some advantage is to be gained in using a better quality of grain for seeding purposes.

To aid in stirring up a general sentiment in favour of better seed, I have always embraced opportunities to address various agricultural meetings throughout Manitoba, the North-west Territories and British Columbia. This work, starting during the winter, was continued during the spring months. During that time I addressed nineteen meetings in Manitoba, including the Annual Convention of the Grain Growers' Association with an attendance of 500 delegates, the Convention of Live Stock Associations, the Annual Meeting of Agricultural Societies' representatives and sixteen meetings of agricultural societies. In the North-west Territories I addressed fifteen meetings of agricultural societies, and the first fat stock show at Regina. In British Columbia, sixteen meetings of farmers' institutes were addressed. At each and all of these meetings the value of good seed and the methods of improving seed was discussed, and most interesting and profitable discussions were aroused.

In introducing and carrying on work to improve the quality of seed, one of the most striking difficulties met with is the apathy that exists with regard to the subject. Where we find large numbers in some districts wilfully sowing the poorest grain they grow, or if they have no poor seed, buying 'feed' wheat for seeding purposes, some idea may be formed of the interest that would be manifested in such a subject. By experience they have found, they state, that one gives just as good results as the other. The better class of observant farmers recognize, however, the advantages that accrue to the users of good seed, and are making a greater effort to obtain a more desirable quality. Another very apparent drawback is the objection and difficulty of working on a small scale as the work of the Association requires. A member may be anxious to do good and careful work, but with the mammoth machinery employed it is very difficult to properly keep small plots separate at threshing time. The enormous amount of seed required—about 8,000,000 bushels—in Manitoba and the North-west Territories, also demonstrates that effective work must be conducted on a large scale.

During the summer and fall an effort was made to visit each of the operating members in Manitoba and the North-west Territories. With the exception of a few who were isolated and at too great distance to warrant the time and expense, all were visited.

Their work, with few exceptions, was satisfactory, carried on with intelligence and thoroughness, and with an appreciation of the benefits to be derived from careful work. In a few cases not sufficient care was taken in the keeping of varieties pure, one of the points worthy of attention that is frequently overlooked in the western part of this country.

EVIDENCE OF IMPROVEMENT.

To give an idea of the opinions of some operating members, I might quote from several letters received recently. After giving his method of operating his seed plot, Thomas Thomson, of Roden, Manitoba, who sold about 250 bushels of improved Red Fife wheat last year at $2 a bushel, says: 'I think that every farmer, whether he becomes a member of this Association or not, ought to sow yearly a small plot with wheat got from hand-selected heads. In this way he would always be sure of having the greater part of his crop sown with good pure seed.'

Fred. J. Dash, Hillsden, Assa., says: 'I am well satisfied with the results of my work, and see a very marked improvement in the Red Fife with which I am operating. So far I have not had much demand for improved seed, but I consider I am well paid for my trouble in the improvement of my crop.'

Lumb Bros., Cartwright, Man., say that they find their trouble amply rewarded in the improvements of their crops even if they never sold any grain.

With regard to general improvement throughout the country, it can readily be seen that with such an extensive area devoted exclusively to grain growing no very great difference can yet be seen, as a result of the work of the Association. With an increasing demand for improved quality fostered by the work of this branch there is slowly but steadily growing a sentiment that will strengthen the work of the Seed Growers' Association. In many districts there is a brisk demand for a thoroughly good quality of seed grain, and this, I am glad to say, is growing steadily. With a demand there is no doubt we will soon have plenty of improved seed.

Moved by F. Kirkham, seconded by Prof. C. A. Zavitz and resolved that the reports of the Secretary and the District Superintendents be received and adopted.—Carried.

The CHAIRMAN.—The reports received will be published in the annual report of the Association, and they are now open for discussion.

Prof. ZAVITZ.—The reports show that the work is being started in a good way. It is interesting to hear reports from districts from the Atlantic to the Pacific . They show the different conditions in the different provinces, and show the importance of having men on the ground who can study the different conditions, which is absolutely necessary to make the work of the greatest advantage in the different sections. The kind of work which will produce the best results in the maritime provinces would not give the best results in the west, but with the men in the field now, as we see by these reports, men who tell us of the work which is being done in the different provinces, it is exceedingly interesting. I do not think it wise for the Association to try to develop too rapidly, I think it is wise to study carefully and move very cautionsly, and as each man in each province studies the conditions, endeavour in the meantime to get each seed grower to do the best work possible.

Mr. NEWMAN.—This work is comparatively little known, and I think it should be brought more prominently before the public. This winter we brought the exhibit from Guelph fair to Ottawa, and placed it on exhibition here, pretty well labelled. Some of this seed was grown near Fergus, and was bought by a gentleman living in that town who knew nothing about it, until he was in Ottawa at the fair, and seeing it on exhibition and noticing the quality, bought all the grower offered for sale. This will illustrate the point I wish to make in this connection.

Mr. MOONEY.—Good seed will not become advertised in one year. As soon as the people find out that you have good seed, even in Manitoba, they will give you fifteen

or twenty cents more per bushel for it. With reference to the enormous prices that have been paid for seed wheat, many of us have purchased seed at a very high price, and it has been found to have a great many different varieties in it. I know a great many instances of that kind, and I therefore appreciate the good work undertaken by this Association.

Mr. BATHO.—In the west, a good deal of interest in the work might be awakened by local organizations. I believe that a provincial organization could be formed which might convene possibly in connection with the Grain Growers' Association. Last winter an address was given before this organization by Mr. Murray. There were five or six hundred farmers in attendance, and I venture to say that until that meeting a great many did not understand the work of the Seed Growers' Association. The Grain Growers' Association consider the commercial side of the question, and hence these men would be interested in the work.

Mr. KIRKHAM.—I think it is only fair to the North-west to explain how it happens that they should sometimes sell their best wheat and buy inferior wheat for seed. Some years the frost comes pretty early, and the crops are all frozen in the northern districts, and as a result there is no seed in those parts but frozen seed. There is, therefore, great danger of farmers sowing this sort of seed rather than importing seed of better quality, and it should be pointed out that while you may occasionally get a fair crop from such seed, you are much more liable to get a poor one.

APPOINTMENT OF COMMITTEE.

A committee was appointed by the chairman, consisting of Mr. Clark, Mr. Mooney and Mr. Grisdale, as a nominating committee.

Evening Session, 8 p.m., June 27.

The convention resumed at 8 p.m., Prof. Jas. W. Robertson in the chair.

PRESIDENT'S ADDRESS.

PROFESSOR ROBERTSON (Chairman).—The secretary-treasurer has placed the chairman on the programme for an address. That is the only time Mr. Clarke has acted contrary to my instructions since we first came together in public life. Even if one were not much accustomed to public speaking, the atmosphere of this place might beguile him to let his tongue run loose. I learned within the last few minutes that up to yesterday the House of Commons had suffered to the extent of about 4,160,000 words since the opening of the session. What a broadcast sowing.....? If some of the seed to-night should fall by the wayside a senator or member of parliament may pick it up, and it may bear good fruit.

Up to the present time the Association has been under the care of the Department of Agriculture to the extent of being really an integral part of the Seed Branch of that department. The Association is only a year old, but within that time it has grown to a membership of active seed growers with hand-selected seed plots, on some 246 farms, dotted all over the Dominion.

This is a time when the government appears anxious to encourage autonomy on the part of certain portions of the Dominion. We hope to get next session an autonomy bill for the Canadian Seed Growers' Association. If the government should be as generous with us as with the portions of the North-west acquiring this partial right of governing themselves, we should be well cared for. Hon. Mr. Fisher, Minister of Agriculture, will speak with reference to this matter. On the whole, we should fare

quite as well under only the financial care of the government as we have done under its paternal care. We will be allowed to do our own planning; and the minister has assured us that what funds are really requisite for the work will be provided.

As president, I congratulate the Association on having had its affairs conducted by Mr. Clark and the other officers, who have shown themselves competent to do its work satisfactorily. In my capacity as president, and also as Commissioner of Agriculture, I had something to do with shaping the policy and directing the work of the Association. Since our last meeting I have resigned from the position of Commissioner of Agriculture, but I continue as keenly interested in the work of the Association as ever. I am glad to learn that the Association is making real growth. It is a powerful educational force in the Dominion. The more I learn about life in Canada the more I see that the material prosperity, and in some measure the happiness and well-being of the people, depend on a proper appreciation and proper action in regard to two things—seeds and weeds. These are two great matters for the consideration and action of the farmers,—to get seed of the right sort, and to give it the best possible chance, so that the best seed may be planted and may have its best results. I believe the Association will help the farmers to see these fundamental principles. If we older farmers had been trained in to a recognition of fundamental principles, instead of discussing shallow and deep ploughing and a lot of other trivial details that do not make any material difference to the issue, we would have been much abler men, and the country might have profited more by our labours.

I wish to express my appreciation of the good work the district superintendents have done and are doing. A great many of the things that bulk largely to the eye or touch are accounted very valuable and very important. Down in Nova Scotia, because they put apples in barrles, they are under the impression that the apple crop is the important crop of the province. I ascertained that the value of the apple crop was about one-thirteenth that of field crops; I found that the hen did more than the apple trees of Nova Scotia. But the hen did its work in rather a small quota at a time, and the result did not loom up like the large apple barrel.

The improvement of seed may be very great, and yet it may be imperceptible to our most delicate tests as applied to the grain itself. This Association is bringing remarkable evidence to Canada that intelligent selection of seed makes larger crops, yielding better seed for the crops of the following year. If the selection of seed did nothing more than what it has done in two years for the mentality of the farmers, it would have accomplished a good deal for humanity. The greatest gains in life are not always made by adding to the sum of material things, but by adding to the thought power of the people who control them. Over this wide Dominion, more thought power has been expended in the improvement of crops in the last few years than was expended before. Where a plot of grain from large plump seed has given a better crop than the plot produced from small seed, the boys begin to see the invariable relationship between the quality of the seed and the crop. That knowledge is a great gain to the people; the progress of the people depends on the thinking, the understanding, and the managing power. That is worth more in the long run than merely getting by a fortuitous combination of circumstances a big crop and a high price. The evidence that selected seed is useful to the country is being multiplied on all sides. It is affecting the educational as well as the agricultural and commercial sides of our national life.

At twenty-five schools I have this year been able to arrange illustration plots of grain from good seed and from poor seed. The crop being stronger from the good seed than from the poor seed is an object lesson to the children. They could not observe the difference in the seed, but they can see the difference in the crop. I think every member of the Association should constitute himself a centre to disseminate his knowledge in the locality where he lives. If we could establish at a thousand schools illustration plots to teach this object lesson, five hundred farmers might see the object lesson at each school. In this manner we could add to the intelligence of the people and to the wealth of the country. Every member should become a missionary to proclaim the

truth of this gospel. The members of the Association who do so, make their fullest contribution to the good of the country.

It is a matter of not very common knowledge that some millions of bushels of grain are required annually to sow the prairies to wheat. It would seem an extravagant thing to say that a man might profitably pay a dollar a bushel extra for selected seed grain. Some farmers would consider that extravagance; but I am quite sure that, on the average, real good selected seed would yield in any kind of season from four to six bushels more to the acre. That would have the effect of making the farms, as real estate, worth much more. That is one of the great questions for farmers and statesmen to consider; and it is a matter concerning our national prosperity which is hardly recognized.

This afternoon I was putting interrogation points as to whether the wheat grain in the fields of the world to-day is any better in quality or any more productive per acre than the wheat grown in Egypt under the collecting hands of Joseph a long time ago. I do not think, as far as one can conjecture, that there has been much progress between the two periods in the quality of wheat or in the average yield per acre. Contrast this with the progress in breeding live stock, in which you see a remarkable difference,—so much so that the picture of a modern pure-bred animal is quite unlike the pictures of the animals in the olden times.

The methods applied to cattle-breeding have brought about in one hundred years more visible change than has taken place in regard to wheat in two thousand years. I believe that our system of selection will do more in ten years than has been accomplished in two thousand years without it. I am glad to see that the district superintendents appreciate this; and I believe that the Association is going to accomplish great results quietly and systematically.

In the grain fields we have multiplying plots for improved registered seed and for general crop seed. In the agencies for diffusing information and illustrations to farmers, such as farmers' institutes, seed fairs, courses in seed judging, reports of experimental farms, and the agricultural press, we have multiplying plots. I have talked to many farmers who, since they began to manage hand-selected seed plots, have done much more observing and reflecting on crop-growing than formerly. They get hold of facts and reflect on them. They gain ability to recognize, to discern, to understand, and interpret in terms of management.

At first our knowledge begins in seeing things as separates; then we go on to perceive relations, to recognize and connect causes and effects. Further on we learn to estimate values of things and processes. By that time in grain-growing we are ready to appreciate the usefulness of the process of selecting seed systematically from year to year. Beginning with an experiment in selection, we discover a process or a plan, and underneath it a principle. We have tried to direct the application of principles by the rules and regulations of the Association. The principles are made clearer to our minds by experiments, by observation, by asking questions of crops and of nature. In the answers we gain enlightenment and encouragement for the future work of the Association. Farmers, like others, do not readily give up what they have gained in their grip upon principles that underlie the improvement of crops; and, therefore, I believe that the Canadian Seed Growers' Association is entering upon a field, the cultivation of which will produce ever increasing benefits to the farmer.

Dr. Wm. Saunders, Director of Experimental Farms, was next called upon to give a paper entitled, 'The introduction and breeding of superior varieties of field crops and the distribution of seed obtained.'

(For Dr. Saunders' paper, see page 35.)

The CHAIRMAN.—I need not remind you that Dr. Saunders has always been a man of large prophetic vision. I do not think he can foretel the weather any further than the rest of us, but he has that peculiar gift exceedingly valuable to a nation, of being able to discern existing and coming needs, and then to form plans to meet those needs when they arrive. It was not every man who foresaw, twenty years ago, that this

country would need better seed wheat. Dr. Saunders began to investigate the surface of the globe, with great discrimination, getting the promising varieties of wheat and bringing them here. While I admire Dr. Saunders' prophetic vision, I never could admire his passion for giving his personal attention to the details of recording work. Perhaps this was too much of a reflection on my own love of ease. I think he is among the great sinners in his habit of working after seven o'clock every night in the year, including Saturdays. But with all that, if one may say in the largest and deepest sense that he, who makes two blades of grass grow where only one grew before, is a great benefactor, he who makes it possible for a whole land to bear much better and greater crops is a still greater benefactor; and I count Dr. Saunders one of the citizens worthy of the highest honour that the nation can bestow.

The chairman next called upon the Honourable Sydney A. Fisher, Minister of Agriculture, for an address.

(For Mr. Fisher's address, see page 42.)

The CHAIRMAN.—I think we can take courage for the future of the Association, since we are assured by the minister that we are to receive what is requisite in revenue from the Dominion to prosecute this great harvesting work for the benefit of Canadian agriculture. I express your judgment with my own when I say that every dollar given to us will be expended as wisely and economically as can be in the interests of seed-growing and of agriculture concerned therewith.

Dr. Webber, of Washington, was next called upon to make a few remarks.

(For Dr. Webber's remarks, see page 41,)

Morning Session, Wednesday, June 28, 10 a.m.

The president in the chair.

The report of the committees appointed to bring in nominations for officers was then received, the nominations being as follows:—

President: Dr. Jas. W. Robertson.

Directors: Prof. C. A. Zavitz, Guelph, Ont.; Messrs. Thos. A. Peters, Fredericton, N.B.; G. A. Gigault, Quebec, Que.; Thos. H. Woolford, Cardston, Ont.; Hugh W. Gibson, Wolseley, Assa.; W. L. Davidson, Bethel, Que.; Morris Middleton, Vernon, B.C.; Thos. S. Waugh, North Bedeque, P.E.I.; J. O. Duke, Olinda, Ont.; John A. Mooney, Valley River, Man.

Moved by Donald Innes, seconded by F. Kirkham, that the report be adopted.—Carried.

The CHAIRMAN.—I thank the meeting for this nomination and election. I shall be glad to continue to do whatever I can to make the Association useful, and to co-operate with the seed commissioner. We may thereby double the efficiency of the work. With two channels—the Association and the department—we should be able to do much good work.

I have now much pleasure in calling on Mr. Clark to read a paper on 'The scope of work for the Canadian Seed Growers' Association.' In introducing Mr. Clark, I need not add to what I have already said, that the Association owes a great deal to his labours and his care. It has been able to serve the country well, largely because of the help that he and the officers under him have given to it.

(For Mr. Clark's paper, see page 44.)

Prof. Frank T. Shutt, Chemist, Experimental Farm, Ottawa, was called on next to give a paper entitled, 'The action of certain smut preventives on the vitality of seed.'

(For Mr. Shutt's paper and discussion thereon, see page 47.)

Prof. W. Lochhead, Ste. Anne de Bellevue, Que., was then asked to give an address on, 'Insect and fungus enemies of cereal crops, and their treatment.'

(For Prof. Lochhead's address, see page 53.)

Afternoon Session, 2 p.m., June 28.

Prof. L. S. Klinck, Agricultural College, Ste. Anne de Bellevue, Que., read a paper entitled, 'Corn breeding in the corn belt.'

(For Mr. Klinck's paper, see page 56.)

Dr. Herbert J. Webber, Physiologist in charge of laboratory of plant breeding, Department of Agriculture, Washington, D.C., gave an address on, 'Pedigree or grade breeding of plants.'

(For Dr. Webber's address, see page 61.)

Prof. C. A. Zavitz, O.A.C., Quelph, Ont., gave an illustrated address on, 'Evidence of improvement in plants by selection.'

(For Prof. Zavitz's paper, see page 70.)

Following Prof. Zavitz's paper was a discussion by members of the Association along the lines in question, and papers were read which had been contributed by members who were unable to be in attendance.

(For these papers, see page 75.)

Evening Session, 8 p.m., June 28.

Dr. H. J. Webber gave an illustrated address on, 'The science of plant breeding.'

This address, together with discussions thereon, occupied the entire evening, and may be found on page 79.

The CHAIRMAN.—I beg to convey to Dr. Webber the hearty thanks of the audience and of the Seed Growers' Association for the lectures he has favoured us with. His lecture to-night was in the nature of a revelation of very wonderful applications of the art of plant breeding. We admire the success of a man who has done much to improve the plants of his own country, and to make the methods he has used there helpful to us in our work here. The world itself is none too wide a field in which such men spend their strength for the advancement of agriculture, for the progress of civilization and for the uplift and benefit of the people.

Morning Session, Thursday, 10 a.m., June 29.

Prof. J. H. Grisdale, Agriculturist, Experimental Farm, Ottawa, read a paper before the Association, which met at the farm, entitled, 'Some common principles which underlie improvement in animals and plants.'

(For this paper, see page 92.)

Afternoon Session, 2 p.m., June 29.

The CHAIRMAN.—I beg to announce that the directors elected by the Association held a meeting this forenoon, and elected the following ten gentlemen to make the completed board of twenty directors: Professors M. Cummings, Truro, N.S., and W. J. Black, Winnipeg, Man.; Messrs. George Harcourt, Regina, Assa.; J. W. Wheaton and W. L. Smith, Toronto, Ont.; Geo. Batho, Winnipeg, Man.; W. Thompson, London, Ont.; John C. Readey, Charlottetown, P.E.I.; L. S. Klinck, Ste. Anne de Bellevue, Que., and Donald Innes, Tobique River, N.B.

Moved by Mr. John A. Mooney, seconded by Prof. Lochhead, and resolved, that the executive be directed to make application to the Minister of Agriculture to secure the enactment of legislation for the incorporation of the Association on the lines of the Bill submitted to parliament in that regard in 1904, with amendment to clause 4 suggested as follows: 'Any person who grows field or garden crops for the production of seed, and who has not been expelled from the Association, may become a member thereof by giving or sending his name or address to the secretary, and by complying with the by-laws and rules thereof; and such person shall thereupon be entitled to the rights and privileges, and subject to the liabilities, of a member as fully as if he had signed the application for the incorporation of the Association.'

Moved by Mr. Batho, seconded by W. L. Davidson, and resolved, that provision be made in the constitution for the appointment of two auditors, one by the Department of Agriculture and one by the board of directors.

Moved by W. L. Davidson, seconded by Prof. Zavitz, and resolved, that provision be also made in the constitution for naming the location for the head office for the Association in the city of Ottawa.

Moved by Prof. Zavitz, seconded by W. L. Davidson, that application be made to the Department of Agriculture to print and issue for distribution a report of the proceedings of the annual meeting.

Mr. S. E. Briggs, of the firm of Steele Briggs Co., Toronto, Ont., was called to read a paper entitled, 'The seedsmen and the Canadian Seed Growers' Association.'

(For this paper, and discussion thereon, see page 96.)

A paper contributed by Wm. Thompson, of the *Farmer's Advocate*, London, Ont., and entitled, 'Methods of giving publicity to the proceedings and achievements of the Association,' was read.

(For this paper, see page 100.)

Following Mr. Thompson's paper was a discussion by W. L. Smith, and J. W. Wheaton, Toronto.

(For these discussions, see page 101.)

Dr. James Fletcher, Botanist, Dominion Experimental Farm, Ottawa, was called on for an address.

(For this address, see page 103.)

Moved by W. L. Davidson, seconded by W. L. Smith, and resolved, that the hearty thanks of the Canadian Seed Growers' Association be tendered to the Honourable the Minister of Agriculture in recognition of the valuable assistance rendered the Association by the Seed Branch of the department, and in the acknowledgment of the annual financial grant to enable the Association to carry on its educational campaign in encouraging the general use of selected seed, with a view to increasing the yield and improving the quality, of the field crops of Canada.

Moved by Geo. Batho, seconded by Mr. Zavitz, and resolved, that the thanks of the Association be tendered to Mr. G. H. Clark, Seed Commissioner, and hitherto the secretary-treasurer of the Association, for the excellent work he has done in connection with the organization of the Canadian Seed Growers' Association, and the carrying on of its work during the year.

Moved by Mr. Smith, that a resolution of thanks be tendered to the district superintendents, who have done so much for the Association during the past year. The motion was carried with applause.

The convention was then closed.

PART II.

CONSTITUTIONS, BY-LAWS AND REGULATIONS, WITH GENERAL EXPLANATIONS OF THE REGULATIONS REGARDING THE GROWING, SELECTING AND PRESERVING OF SEEDS INTENDED FOR REGISTRATION.

PREAMBLE.

The object of the Association is to encourage the general use of improved seed, with a view of increasing the yield and quality of the field crops of Canada.

The Association is the outgrowth of the Macdonald-Robertson Seed Growers' Association, an organization which has demonstrated that much may be accomplished by care in the growing and selecting of seed, according to a system planned and applied with intelligence.

There is a need and opportunity in every agricultural locality in Canada for a number of farmers to make a specialty of growing high-class seed in quantity for the purposes of seed as distinguished from grain for feed or food.

Experience has shown that there is a fair profit to all growers of high-class seeds who manage that special branch of farming with care and intelligence. Other farmers seek from them the supplies of seed for their general farm crops.

All farms and all kinds and conditions of soils are not well adapted for the production of seed of superior quality, of all kinds of crops. Grain and other seeds, for seed purposes, should be produced on lands that are free from noxious weeds and capable of producing those crops at their best in quality and in yield per plant.

In all kinds of farm crops the yield per acre may be materially increased and the quality substantially improved by the use of seed which has been graded up by careful growing and systematic intelligent selection, continued without interruption from year to year. The qualities known as vigour of growth and productiveness in individual plants are transmitted through the seeds to the succeeding crops quite as surely as any desirable characteristics are transmitted to animals from their ancestors.

The production and general use of seed of superior quality for farm crops may be encouraged and assisted by organized effort, under intelligent direction. Associations of farmers making a specialty of growing grain and other crops for seed purposes on well kept and highly conditioned farms should be organized as a means of improving their seed and of educating buyers and farmers generally in the value of high-class registered seed.

CONSTITUTION.

1. The name of this Association shall be the Canadian Seed Growers' Association; it may have a common seal and alter the same at pleasure; may hold real and personal estate and receive grants and devices of the same; may appoint general and executive officers and define their duties; may receive, reject or suspend members; may establish branch associations and may from time to time make rules, regulations and by-laws for the government of the Association and the management of its affairs.

2. The members of this Association may form branch associations for the provinces or districts for the purpose of assisting in carrying the objects of this Association into effect, provided the organization of such branch associations has been authorized by this Association, and their constitution and by-laws have been submitted to and approved by the board of directors of this Association.

3. The object of this Association is to advance the interests of seed growers and other farmers by:—

(*a*) Making regulations respecting the growing, selecting and preserving of seeds of various kinds of farm crops for the guidance of its members;

(*b*) Causing records to be kept of the history of seeds produced by members;

(*c*) Fixing standards for seeds that may be eligible for registration;

(*d*) Publishing information as to standards;

(*e*) Issuing certificates of registration to members by which hand-selected seed or the product therefrom may be known from other seed;

(*f*) Such other means as may be expedient from time to time.

RULES AND REGULATIONS.

4. The general officers of the Association shall consist of a president and secretary and treasurer, and ten directors, which body shall have power to add ten other directors to its number.

5. The president and ten directors shall be elected each year at the annual meeting of the Association.

6. Three vice-presidents shall be elected by and from the completed board of directors.

7. The secretary and treasurer shall be appointed by the directors.

8. The officers and directors of the Association shall form the board of directors of the Association.

9. The executive council of this Association shall consist of the president, the secretary and treasurer and five directors to be elected by the board of directors.

MEMBERSHIP.

10. The Association may admit as members any persons resident in Canada who may choose to make seed growing a special branch of their farm operations, and who conform to the by-laws and regulations of the Association.

11. The Association may admit as honorary members persons who may be directly or indirectly interested in agriculture in Canada, but who may not be producers of seed, and such honorary members shall be eligible to hold office or otherwise enjoy all of the privileges provided for members of the Association.

12. Applicants for membership in this Association may be admitted by vote at any meeting of the Association or of the executive council. Any applicant for membership shall become a member of this Association when duly elected by vote of the officers and members or by vote of the executive council.

NOTICE OF MEETINGS.

13. The executive council shall cause notices of meetings of the Association to be sent to each of the members at least twenty days prior to the date named for holding the meeting.

14. The president shall cause a notice of any regularly held meeting of the board of directors to be sent to each of the members of the said body at least ten days before the date named for holding the meeting.

(*b*) The president shall cause a notice of any meeting of the executive council to be sent to each of the members of the said body at least ten days before the date named for holding the meeting.

MEETINGS OF THE ASSOCIATION.

15. The Association year will commence on the 1st day of July.

16. The Association shall hold at least one meeting each year, the time and place of meeting to be named by the executive council.

17. If from any cause the annual meeting of the Association be not held before the end of the Association year or due notice thereof be not given, the executive council shall cause a special meeting to be called as soon after the end of the Association year as possible, for the purpose of transacting the business of the annual meeting, and at such meeting all matters may be dealt with and acted upon as if such meeting were in fact the annual meeting of the Association.

18. The usual order of business for the annual meeting of the Association shall be:—

The reading and disposal of the minutes of the last meeting.
The reading and disposal of communications.
Report of the board of directors.
Report of the committees appointed by the Association.
Report of officers.
Unfinished business.
Nomination and election of members of the Association.
Election of the board of directors for the ensuing year.
New business.

MEETINGS OF THE BOARD OF DIRECTORS.

19. The board of directors shall hold meetings at such time and place as may be deemed necessary by the president.

(*a*) The directors elected at the annual meeting shall at their first meeting thereafter elect five additional directors, receive the five directors named by the president, and subsequently elect the three vice-presidents and executive council.

20. The usual order of business for the regular meetings of the board of directors shall be:—

The reading and disposal of the minutes of the last meeting.
The reading and disposal of communications.
Report of the executive council.
Report of the committees appointed by the board of directors.
Unfinished business.
New business.

QUORUM.

21. Fifteen members of the Association shall constitute a quorum for the transaction of business at any meeting of the Association, of which due notice has been sent to members as heretofore provided.

22. Seven members of the board of directors of this Association shall constitute a quorum for the transaction of business at any regular meeting of the board of directors.

POWERS AND DUTIES OF THE BOARD OF DIRECTORS.

23. The decisions of the board of directors on any matters pertaining to the workings of the Association or to branch associations shall be final.

It shall be the duty of the board of directors to:—

(*a*) Direct the operations of the Association.

(*b*) Make recommendations regarding the revisions of the constitution, by-laws and regulations as they may from time to time see fit.

(*c*) Define the scope of work for this Association, and for any branch associations that may be formed.

(*d*) Authorize, whenever they may see fit, the formation of branch associations.

(*e*) Suspend or expel members who may be found guilty of violating any of the provisions of the constitution, by-laws or regulations of the Association.

(*f*) Consider and decide upon any appeals that may be made from any rulings of any person or body connected with this Association or any branch association.

(*g*) Consider any appeals or recommendations that may be made by any branch association.

(*h*) Define the course to be followed in the keeping of records of seed produced by members.

(*i*) Define the course to be followed in the issuing of certificates of registration to members.

(*j*) Define the course to be followed in issuing catalogues or otherwise advertising seed produced by members.

(*k*) Take such action as may at any time seem to them advisable to carry on the work of the Association, and to encourage the production and use of high-class seeds of any or all kinds of farm crops.

EXECUTIVE COUNCIL.

24. It shall be the duty of the executive council to transact the business of the Association between meetings of the Association and between meetings of the board of directors.

PRESIDENT.

25. It shall be the duty of the president to preside at all meetings of the Association and of the board of directors, and to give the casting vote in case of a tie.

VICE-PRESIDENTS.

26. It shall be the duty of the vice-presidents to aid and assist the president. In the absence of a president his duties shall devolve on a vice-president.

SECRETARY.

27. It shall be the duty of the secretary to attend all meetings of the Association, the board of directors and the executive council, and keep correct minutes of the same; to send notices of meetings to members; to issue all publications and to keep records of the seed produced by members and issue certificates of registration as directed by the board of directors.

KINDS OF FARM CROPS.

28. This Association shall cause records to be kept of seed of wheat, oats, barley, maize, flax, millet, pease and beans, also seed potatoes, and such other crops as may be decided upon by the Association, that may be grown by operating members.

RESPECTING THE GROWING OF SEED.

29. To entitle the seed of wheat, oats, barley, maize, flax or millet to be eligible for registration by the Canadian Seed Growers' Association, it should be produced on a well cultivated seed plot from a plot that has followed in rotation after:—

(1) (*a*) Clover, pease, beans, or some other leguminous crop;

(*b*) A cultivated crop, such as Indian corn, turnips, mangels, carrots, beets or potatoes;

(*c*) A summer fallow; or

(*d*) Sod;

(2) Pease, beans or potatoes may follow in rotation after any other crop or after a summer fallow.

30. Each member must be a producer of *improved seed,* and must each year conduct a *hand-selected seed plot,* consisting of not less than one-quarter acre of land.

RESPECTING THE SELECTION OF SEED.

31. By the term 'hand-selected seed plot of the first year,' is meant a piece of land bearing a crop produced from seed obtained by selection by hand, of the heads, ears, pods or tubers from plants appearing relatively vigorous and productive for the variety.

(*b*) By the term 'hand-selected seed plot of the second year,' is meant a piece of land bearing a crop produced direct from seed obtained by selection by hand, of the heads, ears, pods or tubers from plants appearing relatively vigorous and productive for the variety, on a hand-selected seed plot of the first year.

(*c*) By the term 'hand-selected seed plot of the third year,' is meant a piece of land bearing a crop produced direct from seed obtained by selection by hand, of the heads, ears, pods or tubers from plants appearing relatively vigorous and productive for the variety, on a hand-selected seed plot of the second year.

32. It is permissible to select heads in sufficient quantity to sow a hand-selected seed plot or plots of a total area not greater than four times the size of the plot from which the heads were selected.

REGISTRATION OF SEEDS.

33. There will be three distinct classes of registration for seed.

(1) In the hand-selected class there will be registered as *'hand-selected registered seed'* only seeds obtained from heads selected by hand from the plants relatively the most vigorous and productive on a registered hand-selected seed plot of at least the third year. The registration certificate of *'hand-selected registered seed'* will show the number of years of antecedent selection, as for instance, 'hand-selected registered seed of the *fourth year'* or the *tenth year,* as the case may be. Such seed will be suitable for use on hand-selected seed plots to produce *'improved registered seed.'*

(2) In the improved class there will be registered as *'improved registered seed'* only grain obtained from a crop produced from hand-selected registered seed. The registration certificate of improved registered seed will show the number of years of antecedent selection of the crop from which it was obtained, as for instance, 'improved registered seed from a crop of the *third year'* or of the *tenth year* as the case may be. Such seed will be suitable for use on improved seed plots to produce *'general crop registered seed.'*

(3) In the general crop class there will be registered as *'general crop registered seed'* only seed obtained from a crop produced from improved registered seed. Such seed will be suitable for use for the general crop of the farm, and the product from it will not be eligible for registration.

KEEPING OF RECORDS.

34. Each member will keep in writing, a record, as nearly accurate as may be, of each year's operations that will show:—

(*a*) The weight of the cleaned seed obtained from the heads or pods, the number and weight of the ears of maize and the tubers of potatoes selected by hand from the *hand-selected seed plot.*

(*b*) The size of the *hand-selected seed plot.*

(*c*) The total yield of improved seed produced from the *hand-selected seed plot.* (When the member is a producer of general crop seed.)

(*d*) The size of the improved seed plot; and

(*e*) The total yield of *general crop seed* produced from the improved seed plot; and

(When certificates of registration are used.)

(*f*) The names and addresses of the persons to whom the seed is disposed, and the quantity and class of registered seed supplied to each person.

35. The executive council shall cause blank record forms to be issued from time to time as they may see fit, to be filled out and properly certified to by members and returned to the secretary-treasurer of the Association.

INSPECTION.

36. Members will at all times endeavour to assist the general officers, and any person or persons whom the executive council or the president may appoint to inquire into or inspect the operations of members in the growing, selecting, preserving or disposing of any seed intended for registration or for which certificates of registration are issued.

HEAD OFFICE.

37. The head office of the Association shall be at the city of Ottawa, in the province of Ontario.

AUDITORS.

38. Two auditors shall be appointed to examine the accounts of the Association, one of whom shall be appointed by the Department of Agriculture and the other by the board of directors.

GENERAL EXPLANATIONS REGARDING THE GROWING, SELECTING AND PRESERVING OF SEEDS INTENDED FOR REGISTRATION.

Some general explanations of the regulations of the Asssociation in respect to the growing, selecting, preserving and disposing of seeds intended for registration are herewith presented. They have been drafted in accordance with the sense of the general discussion of the first annual meeting of the Association. Their publication has been approved by the executive council. The matter contained therein may prove instructive and helpful to applicants for membership and to members of the Association.

RESPECTING VARIETIES AND VARIETY NAMES.

The Association recognizes that although some varieties of field and garden crops —sometimes termed standard varieties—readily adapt themselves to a wide range of conditions of soil and climate, there are numerous other sorts of special merit, each of which may be superior to any other variety, in the specific environment suited to it. The Association does not place any limit on varieties for registration; operating members may have seeds of any kind of crops of which records are kept, registered under any type or variety name they may choose to adopt. When type names only are used the name of the grower may also be attached, *e.g.*, 'Brown's White Flint Corn.'

It is also recognized that there may be appreciable differences between the strains of seed of the same variety so far as the capacity of the seed to give a large yield is concerned. It is believed that the best seed of any variety may be grown under conditions that are favourable to producing individual plants of that variety at their best in quality and quantity of seed produced per plant. Such seed is likely to transmit its properties.

THE FOUNDATION STOCK.

The first important step prior to choosing the foundation stock of seed for any crop is to ascertain the variety best suited to the locality and particular farm where it is to be grown. Not only should the best variety be selected, but also the best obtainable seed of that variety, as judged from the standpoint of trueness to type and of the vigour of growth and productiveness of the mother crops for several preceding years.

SELECTION, PREPARATION AND CARE OF SEED PLOTS.

Although in *clause 29* of the constitution it is specially recommended that crops of seed for registration shall follow in rotation after certain other crops, the Association, in the meantime, depends on the good judgment of its members in the selection, preparation and care of all seed plots. Certificates of registration will not be issued for any seed in any year, unless the crop on the seed plots producing such seed merits recognition for the seed.

The Association recommends that its operating members do not produce as a staple crop more than one variety of any kind of crop on the same farm. It is desirable, as far as possible, to avoid all conditions which may be conducive to the mixing of varieties. Seed plots of self-fertilizing crops—wheat, oats, barley, pease and beans—or of potatoes—need not be separated widely from other varieties. Of those crops which naturally cross-fertilize—corn (maize) and millet—the seed plots should be widely separated. In order to overcome cross-fertilization with corn, the seed plots should be at least 40 rods from any other variety of corn.

THICK VERSUS THIN SEEDING FOR SEED PLOTS.

Thick seeding abridges the natural tendency in plants to produce stools or branches in order to take advantage of all the available surface space in an endeavour to perpetuate their kind. Excessively thick seeding is strongly conducive to depreciation of vigor and productiveness in individual plants. With some kinds of field crops, it hastens maturity.

Thin seeding provides more space for individual plants, and, in consequence, a better opportunity for acquiring the necessary supply of plant food for vigorous growth. It encourages the tendency in plants to form stools or branches, the development of which retards maturity.

If sown early in the season on reasonably fertile soil in a good state of cultivation, a comparatively small amount of seed will suffice, provided that the weather conditions are favourable to growth during the early part of the growing season. It is well, as a rule, to increase the amount of seed used as the date of seeding becomes later.

Seed plots—especially hand-selected seed plots—should be thinly seeded in all sections where the climatic conditions will permit. The use of a grain drill having every alternate drill tube plugged, thus making the drills of grain 14 inches apart with seed sown at the rate of one bushel per acre, has been found to give good results on clean land for hand-selected seed plots in the provinces of Ontario and Quebec. It would not be wise to hazard crop maturity in order to provide the most favourable conditions for vigorous growth of the crop on seed plots in all parts of Manitoba and the North-west Territories.

DEFINITION OF TERMS.

1. (*a*) '*Hand-selected Seed*' is seed selected by hand from relatively vigorous and productive plants.

(*b*) '*Hand-selected Registered Seed*' is hand-selected seed obtained from a crop produced from hand-selected seed in at least the three generations immediately preceding it.

(*c*) A '*Hand-selected Seed Plot*' is a plot of land bearing a crop produced direct from 'Hand-selected Seed.'

2. (*a*) '*Improved Seed*' is the product of the 'Hand-selected Seed Plot.'

(*b*) '*Improved Registered Seed*' is the product of the crop produced from 'Hand-selected Registered Seed.'

(*c*) '*Improved Seed Plot*' is a plot of land bearing a crop produced direct from 'Improved Seed.'

3. (*a*) '*General Crop Seed*' is the product of the 'Improved Seed Plot.'

(*b*) '*General Crop Registered Seed*' is the product of the crop produced from 'Improved Registered Seed.'

THE PROCESS OF HAND-SELECTION.

In the practical application of the principles of improvement in plants by hand-selection, the process of hand-selection should not be cumbrous. Before the work of selection is commenced the operator should have the desired type fixed in mind. The work of hand-selecting may then be done rapidly and systematically. Seed from the best plants among many that have had equal opportunities should be taken, rather than from plants that have been incited to extra growth through being provided with specially favoured conditions.

Mixtures of foreign varieties should be carefully guarded against. Many undesirable sorts of cereal grains—especially of wheat—are known to be characterized by having large heads. These should be eliminated. It is recommended that the threshed and cleaned seed from hand-selected heads or pods be hand-picked and all inferior grain or grains not true to the desired type discarded.

The process of hand-selection from the hand-selected seed plot must be continued from generation to generation without interruption. It is recommended that a small quantity of hand-selected seed from the hand-selected seed plot of each year be kept in reserve for one year, to be used in case of absolute failure of crop on the hand-selected seed plot in any year. Partial crop failure on hand-selected seed plots caused by rust or blight should not deter the work of hand-selection from such plots. Heads or pods of grain from those plants which have shown the greatest power to resist rust or blight should be taken. Selection from the fully matured standing crop has many advantages over selection of large heads or pods from harvested grain.

SEED CORN (MAIZE).

All seed plots of Indian corn must be sufficiently isolated to prevent cross-fertilization. The hand-selected seed plot should be separated from other seed plots of the same variety.

The hand-selected seed plot should consist of not less than 20 rows at least 3½ feet apart, planted in hills not less distant apart, each row having at least 50 and not more than 75 hills. The young plants should be thinned to not more than 3 per hill.

Each of the 20 rows should be planted with corn from a single ear. The 20 ears thus required to plant the hand-selected seed plot, as well as the plants which produce them, should be uniformly true to the desired type.

To avoid fertilization of all good plants with pollen from plants of inferior growth, all undesirable plants in the seed plots should be detasseled before the pollen is mature.

The selection of hand-selected seed should be as follows:—

(1.) One or more of the best out of the 20 rows;

(2.) Fifty or more of the best ears out of the best rows;

(3.) Twenty of the best ears out of the total number of the ears selected.

POTATOES.

The hand-selected seed plot of potatoes should be planted in hills not less than 3 feet apart each way. One whole potato only of the desired type should be planted in each hill.

The selection of hand-selected tubers of potatoes should be as follows:—

(1.) Mark the best hills as judged from general appearance of the top of growth at approach of maturity.

(2.) When fully matured, dig all marked hills first and take hand-selected tubers only from those hills which have produced large yields of potatoes of uniform size and type.

KEEPING OF RECORDS.

Operating members are requested to keep for reference records of all seeds produced by them. All blank record forms are issued to members in duplicate—one to be filled out and returned to the secretary of the Association, and the other to be retained by the member.

The records of yield of hand-selected, improved and general crop seed must be of clean seed that is ready for use. The statement is taken by the Association as an application on the part of the member for certificates of registration for the total amount of each kind of seeds named therein that is eligible for registration.

Records of yields and reports showing the amount of seed held for sale should be forwarded to the secretary of the Association before the end of the calendar year. The Association may issue catalogues for general distribution for the purpose of advertising seed produced by operating members.

PRESERVING OF SEED.

Threshed and cleaned seed of cereal grains should be stored in a dry cool place.

Smut infested wheat, oats or barley should be effectively treated by the grower, and the smut spores killed before being sold.

Special care should be taken to protect seed grain against the ravages of insect pests and the spread of insects through the medium of seed grain.

Seed pease that are infested with pea weevil should be threshed and effectively treated with carbon bisulphide as soon as possible after maturity.

Seed corn should be thoroughly dried and preserved in the ear in braided plats, on racks or in bins or cribs specially designed to prevent injury from damp.

DISPOSAL OF REGISTERED SEED BY MEMBERS.

The Association expects all members to comply with the following clause of the 'Seed Control Act, 1905':—

3. No person shall sell, or offer, expose or have in his possession, for sale, for the purpose of seeding, any seeds of cereals, grasses, clovers or forage plants unless they are free from any seeds of the following weeds:—Wild Mustard or Charlock, (*Brassica Sinapistrum,* Boiss); Tumbling Mustard, (*Sisymbrium sinapistrum,* Crantz.); Hare's Ear Mustard, (*Coringia orientalis, Dumort.*); Ball Mustard, (*Neslia paniculata,* L. Desv.); Field Pennycress of Stinkweed, (*Thlaspi arvense,* L.); Wild Oats, (*Avena fatua,* L. and *avena strigosa,* Schreb.); Bindweed, (*Convolvulus arvensis,* L.); Perennial Sow-Thistle, (*Sonchus arvensis,* L.); Ragweed, (*Ambrosia artemisiaefolia,* L.); Great Ragweed, (*Ambrosia trifida,* L.); Purple Cockle, (*Lychni Githago,* Lam.); Cow Cockle, (*Vaccaria Viccaria,* L. Britton); Orange Hawkweed or Paint Brush, (*Hieracium aurantiacum,* L. and *Hieracium praealtum,* Vill.); and from *Sclerotia known as Ergot of Rye, (Claviceps purpurea,* Tul.), unless each and every receptacle, package, sack of bag containing such seeds, or a label securely attached thereto, is marked in a plain and indelible manner—

(*a*) with the full name and address of the seller;

(*b*) with the name of the kind or kinds of seed;

(*c*) with the common name or names of the aforenamed weeds, the seeds of which are present in the seed sold or offered, exposed or had in possession for sale.

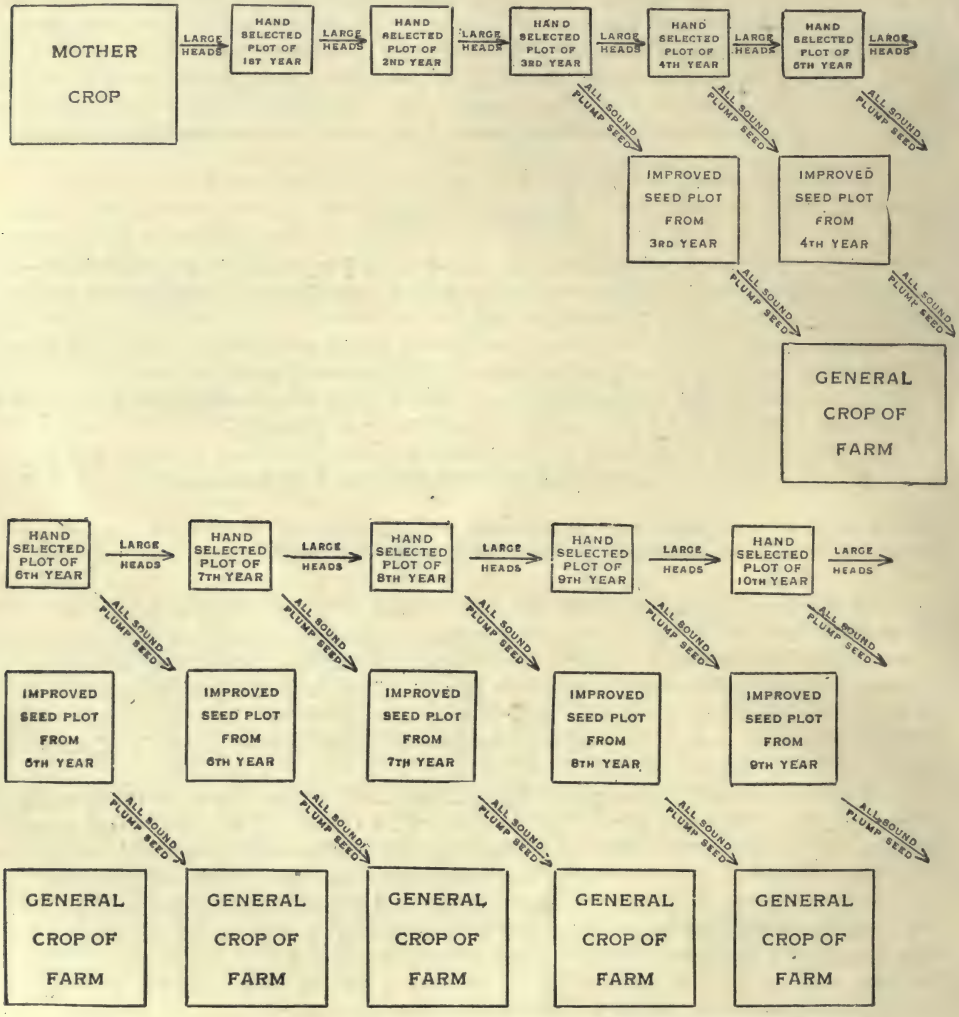
That a statement showing the per cent of vital seed be supplied with each and every lot of registered seed sold, the vitality of which falls below 90 per cent.

All hand-selected registered seed of wheat, oats, barley, pease, beans and millet sold or disposed of by members shall be delivered to the purchaser in the head or pod, unless otherwise ordered.

All registered seed corn sold or disposed by members shall be delivered to the purchaser on the ear unless otherwise ordered.

CERTIFICATES OF REGISTRATION.

Certificates of registration will be issued each year for the hand-selected, improved and general crop seed that may be eligible for registration. The signature of an operating member to such certificate of registration is a guarantee on his part that the seed for which the certificate is issued has been produced in accordance with the by-laws and rules of the Association.



JAS. W. ROBERTSON.

PART III.—PAPERS AND ADDRESSES PRESENTED.

FIELD CROPS AT THE EXPERIMENTAL FARMS, AND THE DISTRIBUTION OF SEED SO OBTAINED.

(By Dr. Wm. Saunders, *Director, Dominion Experimental Farms.*)

In Canada, where the prosperity of the people depends mainly on successful agriculture, every circumstance and condition which bears on good crops is worthy of the most careful consideration. Among the chief factors which have their influence on good crops from year to year are: The proper preparation of the soil, a sufficient supply of plant food, favourable conditions of heat and moisture, early sowing, and the selection of plump and well matured seed of the best and most productive sorts. Some of these factors are more or less beyond man's control, but the sowing of good seed of the most productive sorts is essential if the greatest success is to be achieved, and the use of such seed is a factor largely controllable by the farmer. We know that in nature as a rule, what a man sows, that shall he also reap, hence, no man need expect, if he sows inferior seed, that he will realize superior crops.

In the comparatively recent advancement of agriculture in Canada, which is happily continuous, the importance of placing good seed of improved varieties within reach of the farmers of this country was early considered. In the first important step taken by the government of Canada for the promotion of agriculture, in 1886, when the Act of Parliament was passed under which the Experimental Farms were established, the introduction, growth and distribution of good seed was made one of the essential duties of these useful institutions. It was provided that they should 'test the merits, hardiness and adaptability of new or untried varieties of wheat or other cereals, and of field crops, grasses and forage plants and disseminate among persons engaged in farming, upon such conditions as are prescribed by the minister, samples of the surplus of such products as are considered to be specially worthy of such introduction.'

The Experimental Farms were thus to be made active agents in the introduction into Canada of new and promising varieties of all the more important farm crops, and the testing and dissemination for further trial of such sorts as were likely to be useful to the farmers of the country. From the outset the importance of securing early ripening varieties of cereals of high quality and productiveness, for test in Canada, was fully recognized, and other countries were promptly laid under tribute. The first importation made by the Experimental Farms within a few months of their organization was of an early maturing wheat, claimed to be one of the earliest and best sorts grown in northern Russia. Of this wheat, known as Ladoga, 100 bushels were imported early in the spring of 1887, when 667 samples were sent out to leading farmers in Manitoba, the North-west Territories and other parts of the Dominion, for trial. Other varieties of seed wheat were also obtained, and portions of these similarly distributed, bringing the total distribution that year up to 1,149 samples. Twelve hundred pounds of the Ladoga wheat were distributed among the Indian agencies in the North-west, to be sown on the Indian reserves, and a portion was kept to be tested on the Experimental Farms.

Many other varieties of important farm crops were imported that year from other countries, notably from England, France and Germany. These included 67 varieties of spring wheat, 31 of barley and 69 of oats. There were also brought from Europe 245 different sorts of potatoes.

Seeds of a large number of different sorts of trees, shrubs and plants were also secured. The Royal Gardens at Kew, England, supplied 335 packages; the Imperial Botanic Gardens at St. Petersburg, Russia, 300 packages; and from the Botanic Garden of the Imperial College of Agriculture at Tokio, Japan, 110 sorts were procured. As supplementary to these important donations, 1,200 different varieties were secured by purchase from dealers in Europe and America. Collections were also obtained of the seeds of Canadian trees and shrubs of many different sorts. In this manner there was laid during the first year of the existence of the Farms a broad foundation for future work, which has since been carried on, on an ever increasing scale.

Among the samples of seed grain secured the first year there were 28 varieties selected from grain offered for sale at the Corn Exchange in London, England, and among these there were several varieties of wheat from India. These proved to be unexpectedly early in ripening. Subsequently it was learned that these were varieties of wheat grown in the higher altitudes of the Himalaya Mountains, which on account of their early ripening habit were likely to be of value to Canada. Correspondence was opened with the government of India, and through the kind interest taken in the subject by the late Lord Dufferin, who was then Viceroy and Governor General of India, there was got together from different parts of India, by the directors of agriculture in the several provinces, a collection of different sorts of cereals likely to be useful for experimental cultivation in Canada. These consisted of wheat, barley, buckwheat, millet and pulse. Some of the wheats were obtained from crops grown on the plains, others from different elevations in the mountains, some as high as 11,000 feet. Barleys, also, were had from similar localities.

When received these samples were cleaned and distributed for test among the several Experimental Farms. Many of the varieties were early in ripening, and some were of excellent quality; but none of them were as productive as the best sorts which were then growing in this country. After five or six years' trial, as it was found impossible to make these wheats produce crops equal in volume to those already grown in Canada, the cultivation of most of them was gradually given up, but not before a number of crosses had been made of the earliest Indian wheats with the vigorous and productive sorts grown in Canada.

Recognizing the importance of procuring seed of the very best quality, persistent efforts were made by the Experimental Farms to improve seed in this way. The varieties secured from time to time, whether obtained from other countries or originated here by crossing, have been carefully tested side by side, and their relative earliness, productiveness and quality ascertained.

The question is often asked, especially by visitors from other countries, 'How can your farmers obtain samples of these sorts for the improvement of their seed?' Provision is made for their introduction and general dissemination as follows: The most promising sorts are grown in large fields at the several Experimental Farms, where great care is exercised in keeping the different varieties pure and true to name. A large proportion of the produce so obtained is sent every year to Ottawa, where a general distribution is made for the improvement of seed throughout the Dominion. The samples available can only be had by personal application, and only one variety is obtainable by one applicant each year. The samples of wheat and barley weigh five pounds each, and those of oats four pounds, sufficient in each case to sow one-twentieth of an acre. Those farmers who take good care of the samples received usually have at the end of the second season sufficient seed for a considerable acreage, and henceforward have all they require for their own use and some surplus to sell to their less careful neighbours.

It is remarkable how rapidly a supply of grain may be built up from a single four or five pound sample. Take, for instance, a sample of oats. The four pounds received will, if well cared for, usually produce from three to four bushels. This sown on two acres of land will, at a very moderate estimate, give one hundred and sometimes upwards of two hundred bushels; but, taking the lower figure as the basis for this calculation, the crop at the end of the second year would be sufficient to sow fifty acres, which

at the same moderate computation would furnish 2,500 bushels as available for seed or sale at the end of the third year.

The critical point in these tests is the threshing of the grain at the end of the first season, and it is here that many fail to get the full advantage open to them. The product of the one-twentieth of an acre plot which the four pound bag has sown is frequently threshed with a large machine, which it is difficult to thoroughly clean, and in this way the product becomes mixed with other varieties and practically ruined. At the Experimental Farms we thresh the product from many of the small plots of grain by cutting off the heads, placing them in sacks, and repeatedly beating these with a stick and winnowing until most of the chaff is got rid of and the grain made clean enough for sowing. Where the farmer is to use this seed for his own sowing it is not necessary that the sample be absolutely free from chaff. It is, however, most essential, if he is to get the full benefit of his experiment, that the grain be kept free from all admixture with other sorts. Farmers are expected to harvest the product of their experimental plot separately and store it away carefully, threshing the product by hand, either with a flail or in such other manner as they may prefer. Cutting the heads by hand and placing them in sacks may be a convenient method of harvesting in some cases. The results to be gained will abundantly repay the careful handling of the grain in this way.

It is surprising how rapid has been the growth of the demand for these samples of grain. As already stated, the number sent out the first year after the establishment of the Experimental Farms was 1,149; the second year it was 2,150; and the third year, 2,760. By this time the work of the Farms was fast becoming known and appreciated. A large number of farmers were made aware of the advantages awaiting them in these pure varieties of improved seed, and in 1890, the fourth year of the existence of the Farms, 15,552 applicants were furnished with the samples of seed they desired. From this time on the growth was still rapid, until 30,000 and upwards was reached annually. For the past ten years the average output has been 36,406, which is near the limit of our present capacity to supply. That capacity is necessarily limited, as we have first to grow the grain for distribution, for which we must have a sufficient quantity of seed of the varieties most desired; then the fields are watched and the standing crop hand-picked to remove all foreign plants. Extra care is taken in threshing and cleaning, and after that, if any intermixture of anything foreign is discernible in the sample, it is hand-picked before sending it out. To accomplish all this, and get the large demand for samples satisfied, send circulars of instruction with the sample, and prepare indexes of the names of the applicants for ready reference as the samples go out, necessitates the utmost care and expedition, so that all this seed may get into the hands of the farmers applying in time for seeding. To complete this work for a single season requires the use of from seventy to seventy-five tons of the choicest material. During the spring of 1905 more than 42,000 samples have been distributed from the Experimental Farms, and taking the whole period during which this useful work has been conducted, more than 500,000 samples have been sent out. No such gigantic and practical co-operative scheme as this has ever been attempted before. Canadian farmers have everywhere gladly joined in this important work, and the benefit to Canadian agriculture has been enormous. There is scarcely any part of the Dominion where evidences of this far-reaching work are not manifest.

For four years (from 1899 to 1902) the experiment was tried of sending to a select list of farmers a double quantity of seed, so that each of these might have enough for the sowing of one-tenth of an acre. During this period more than 12,500 such samples were sent out; but it was found impracticable to continue to send these larger samples to all who applied for them, and so much dissatisfaction was felt among those who were unable to obtain the larger quantities that it was thought best to discontinue this special privilege and to treat all the applicants alike.

No plan, however liberally devised, is liberal enough to satisfy all, and while the great bulk of the farming community highly appreciates the benefits which this distribution confers, occasional complaints are made that the samples are too small, and that

not less than two bushels of grain should be sent to each applicant. If such quantities were sent the distribution must necessarily be limited to comparatively few individuals, which would be very unfair and impolitic. The Experimental Farms have also been criticized for not arranging to have seed grain available to farmers by purchase in lots of two bushels and upwards. The advantages to be derived from meeting such a demand are so manifest that the criticisms might have been well deserved, but for the fact that this has been the common practice at the western Experimental Farms for many years past, and every season after the regular distribution of smaller samples has been provided for, all the surplus stock has been sold to farmers in quantities of from two to five bushels each. During the past season more than 200 farmers have been so supplied. Records of the number of these larger lots sold have appeared in many of the annual reports, and a simple reference to these documents would have shown the absurdity of such criticisms.

Improvement in the seed grain used in Canada has been brought about by three different methods, as follows: (1) The introduction of varieties grown in other countries; (2) the production of new sorts by cross-fertilization, where the effort is made to combine in one the desirable qualities found in two or more different sorts, and (3) the improvement of existing varieties by judicious selection. The objects in view in all such efforts are to bring under general cultivation varieties which are highly productive, earlier in ripening and equal or superior in quality to the best sorts now in use. The first of these, covering the introduction of cereals from other countries, has already been referred to, and the methods adopted to place the best of these varieties within the reach of farmers throughout the Dominion have also been explained, and these methods apply to cereals from every source. We shall next refer to the breeding of new cereals, and as the subject is a large one my remarks will be restricted to the breeding of varieties of wheat.

Our existing good varieties have been carefully looked after, and large quantities of pure Red Fife have been grown every year, and distributed among farmers in the North-west country, and that has been a great help towards keeping this excellent variety in a comparatively pure condition.

The origin of life is shrouded in what appears to be impenetrable mystery, but its continuance by the reproduction of existing species and their modification by the mixing of species and varieties is largely under the control of man. The results obtained from such efforts appear to be regulated by certain laws, which as yet are but imperfectly understood. New light, however, is dawning on this most interesting field of labour, and before many years there is no doubt that much progress will be made.

Let us now take for examination a single kernel of wheat, and see what lessons can be drawn from this source. To man, whose daily bread is furnished by the wheat berry, the problems connected with its constitution and growth are most interesting.

The mature kernel is a single seed inclosed in tightly fitting walls, which fold inward, forming a fold or groove upon its upper surface. The skin, which consists of three layers, when crushed and ground forms bran and shorts. The interior of the wheat kernel, which is composed of starch, gluten, &c., when ground furnishes flour in the proportion of about seventy to seventy-five per cent of the whole. The germ or embryo of the plant, in which the principle of life lies dormant, is found at the lower end of the kernel, and is surrounded by a supply of food material. When the grain is sown and conditions are favourable for germination, the germ is awakened to life and begins to feed on the store of nutriment by which it is surrounded. Shortly the rootlets protrude and strike into the soil, while the blade shoots upwards to the light. The growth of the wheat plant from seed to maturity is one constant series of chemical changes. Various food elements in the form of mineral matter, such as potash, phosphoric acid, lime, &c., together with water and nitrogenous compounds, are taken up from the soil by the roots, while in the leaf the different compounds required to build up the plant are elaborated. The elements composing these are taken largely from the air. Surplus material is stored in the leaf and stalk, which is finally transferred rapidly to the seed as the plant matures. All this preparatory work admits of infinite modifi-

cation to suit the individuality of the plant. There is a broad and general law underlying production in nature, that 'like produces like'—we do not 'gather grapes of thorns, nor figs of thistles.' The seed contains in embryo the perfect plant; its details and characteristics are all enfolded in its substance, awaiting favourable conditions for germination, which, once started in suitable soil, results in a gradual unfolding of the mature specimen. It is during the formation of the seed that the characteristics of the future plant are laid down.

As our growing wheat plant advances towards maturity a head pushes gradually out from the stalk, which, with the lengthening of the straw, finally stands out from all its surroundings. If we examine this structure we find that it is formed of a number of spikelets supported by a central stalk bent zigzag, first to one side, then to the other, forming a series of notches and bearing a number of flattened spikelets, one of which grows on each notch. Each spikelet consists of a group of florets, usually five or six, arranged in a fan-like form. The two lower flowers mature first; the second pair follow later, and those at the top, last. The first two flowers in each spikelet are usually fertilized and mature without mishap. The other sometimes, partially or wholly fail through unsuitable weather, and in that case the weight of the crop is usually light. If the spikelets are well filled, the crop is always a satisfactory one. Wheat is usually self-fertilized, the pistillate and staminate portions of the flower being near together, within the same chaffy enclosure. The stamens with their anthers usually overhang the top of the feathery pistill more or less on which when mature the pollen is discharged. The pollen consists of a multitude of very minute round bodies, which, when dropped on the succulent pistil, send out from their substance a tiny thread which penetrates the pistil, and, passing downward through its substance, is gradually lengthened until it reaches the ovary near the base, where it penetrates the ovule and fertilizes it. This act of fertilization impresses the seed with its future characteristics, and as the seed grows these are embodied in its substance and to a considerable extent transmitted to its progeny. When wheat is fertilized by its own pollen the kernels produced resemble one another very closely, although occasional differences occur through variation; but where cross-fertilization is effected the character and structure of the grain is so modified as to partake more or less of the characteristics of both parents. This variation, or sporting, is often continued through several generations, until finally the types become fixed and the varieties reproduce themselves with little or no change.

In the cross-fertilizing of wheat the head should be selected and worked on soon after it has pushed out from the sheath. At this early stage the kernels have not begun to form, and the places which they are destined to fill are occupied with the partially developed flowers. The floral chambers are covered with two layers of chaff, the outer one of which is torn off or bent back with a pair of finely pointed forceps, and the inner one pulled back by seizing it near the tip and bending it downwards, which exposes the flower to view. The anthers are then carefully examined, and, if their condition is sufficiently advanced to offer the possibility of any of the pollen having been shed, the spikelet to which it belongs is torn off and thrown away, and other flowers opened until some are found in the desired condition, with the stamens green but almost mature. These are removed with much care, as the slightest injury to the soft and delicate pistil will cause it to wither. The flower is then covered by replacing the inner coating of chaff in its natural position. After a sufficient number of selected flowers have been operated on all other portions of the head are torn off and rejected.

Having previously collected heads of the variety or species which is to serve as the male, flowers are sought which contain anthers fully matured and covered with pollen. Then the individual flowers prepared for fertilization are opened again in succession, and the soft feathery pistil is gently touched with one or more of the pollen-bearing anthers from the other variety until a perceptible quantity of the fertilizing powder has been applied, when the flower case is again closed. After all the flowers in a prepared head have been operated on, it is wrapped in thin paper so secured by

tying as to prevent the possibility of access of other pollen. As a further precaution against possible injury, the covered head is then tied to a piece of stick or bamboo cane, where it remains untouched until harvest time, when any kernels which have been formed will be mature and may be safely gathered. Each kernel when sown the following season will form the starting point of a new variety, or, indeed, of a number of new varieties.

The single plant from any of these kernels grown the first year will produce heads all alike, and these will usually resemble closely the variety on which the kernel has been produced. Occasionally it will take after the plant from which the pollen has been gathered. If the cross has been successfully made, the grain obtained from the plant of the first year's growth, when sown the next season, will usually produce several different forms, some resembling one parent and some the other, while other plants will produce heads more or less intermediate in character. After selecting the most desirable type or types, all other forms are discarded, and only those retained from year to year which conform to the type or types selected. After several seasons of careful selection, the type usually becomes fairly permanent. Variations will, however, occasionally occur, and such should be separated whenever they appear, if the new grain is to be preserved true to the chosen type.

In efforts to cross cereals many failures may be looked for. A partial record of the earlier crossings done on wheat at the Experimental Farms showed that from 1,650 flowers carefully worked only 220 kernels were obtained—about one in eight. The first wheat crosses were produced at the Experimental Farm in 1887. These were mainly between Ladoga and Red Fife. Subsequently other varieties were used, and large additions were made to their number. Some very promising sorts have been produced from these earlier crosses, some of which are now grown quite largely in the North-west country.

In the growth of the wheat berry an internal frame work or net work is first built up of glutinous compounds, the ramifications of which extend through all parts of the seed. Subsequently the berry becomes plump through the interstices becoming packed with starch granules.

In carrying on the work of cross-breeding for the first few years, the work was done chiefly by myself; but during the next ten or twelve years I received some valuable help. Able assistance was rendered me in cereals by Mr. W. T. Macoun; also by Dr. A. P. Saunders. More recently the bulk of the cross-breeding work has been done by Dr. C. E. Saunders, who has been wonderfully successful not only in cereals but in fruits and other lines.

Since the appointment of Dr. C. E. Saunders as experimentalist, in 1902, a large number of additional crosses have been made, and much attention paid to the work of purification and selection of seed, especially of the varieties of wheat grown on the Experimental Farms. Many of these were found to be more or less mixed, not only those from commercial sources, but also many of the cross-bred sorts. Where the respective parents of the cross-bred wheats have varied in the colour of the skin of the kernel or in the colour of the chaff, more or less variation has been found in the colour of the wheat and the chaff has been found to vary in colour also through the sporting of the grain. The colors of the types of wheats grown have been definitely fixed, and much time given to the selecting of single kernels quite true to type, which have been picked out in sufficient quantities to sow good sized plots. From these plots pure seed has been obtained sufficient to supply in many cases the uniform trial plots at the several Experimental Farms, and it is hoped that these pure strains will in two or three years more be sufficiently multiplied to admit of their being widely distributed. Much attention has been paid to the question of earliness in ripening. By new combinations in cross-breeding, additional earliness has been secured, and the best of the earliest wheats now being propagated will ripen fully two weeks earlier than the Red Fife, and are of excellent quality, but are not expected to be quite equal in productiveness. Several selected strains of Red Fife have been found which ripen three or four days earlier than the ordinary form, and further efforts are being made to secure

greater advantages along this line. Selected strains of Preston, Stanley, Huron, Early Riga, Percy and many other sorts have been made, which carry with them improved quality and sometimes increased earliness. The foundations for future progress are being thoroughly and carefully laid. Ready methods have been worked out by the experimentalist for determining approximately the relative quality of wheats even where only a few kernels are available, so that all inferior wheats among the new sorts under trial can be promptly detected and discarded. The researches of the experimentalist are also now greatly aided by the possession of an experimental roller-process mill, by means of which the proportion of the different grades of flour in a given sample of wheat can be determined and its value for milling ascertained even where no more than a pound or two of the grain is available. By means of a small baking plant the value of the flour for bread-making can also be ascertained, thus making the tests complete. These facilities will greatly expedite the work of determining with very little delay the relative value of new cross-bred wheats as well as newly introduced varieties.

It is a great satisfaction to me to know that this most important division of the Experimental Farm work, which I have for so many years striven earnestly to make effective, and with some measure of successs, will in the future be carried on to much greater advantage than it has in the past, and under the charge of a thoroughly trained worker advancement will, I believe, be rapid. The improvements already in sight are most encouraging. The gain made with some of the new wheats of high quality, of two weeks, over Red Fife, in earliness of ripening, will be of immense advantage to the Canadian North-west, while the improvements made in other sorts of wheat and in other cereals lead us to look for great progress. I sincerely trust that, through the advancement already made and in view, the Experimental Farms will in future be brought still more prominently before the farming public as the most reliable source for good and pure seed grain, and that this work will add much to the profits of farming in this country.

Dr. WEBBER.—Do you stop to realize that the plant breeders, of whom you are representatives, are really changing the geography of the world? I think we ought all to join the geographical asssociation. I remember reading in a litttle geography which I studied a few years ago the limitations of our wheat areas, of our apple areas, and our pear areas, and orange areas, and we read that orange growing—in these books just a few years ago—and apple growing were limited to certain areas. Now, stop to think of it. Those areas will suddenly have to be changed to three or four hundred miles further north. We read of the winter wheat area being limited largely to Missouri, to Kansas, but now, through the efforts of the breeder, those limitations are gradually drifting northward, and we find winter wheat crops, the main crop I believe, in Iowa and Nebraska pushing their way northward until they are grown generally in Southern Minnesota, South Dakota, and areas like that.

To-day I was surprised to find excellent winter wheats growing on your Experimental Farm here. Those are not all the result of the soil. They are largely the result of gradual selection, of which I will speak more in detail to-morrow, the gradual grade breeding which modifies, in time, any plant or animal. In the same way geography is being moved in other regions of the country. Back in 1876, Peter Cooper, at Philadelphia, discovered what is now known as the Cooper pear, which we now know to be a hybrid of the Chinese pear, with some variety of European pear. Now, previous to that time pear culture was only possible through an area extending as far south as Southern Virginia, but as you passed south of that into the Carolinas and further south pear culture ceased to exist. But horticulturists in this country, by importation and introduction, found out that the eastern United States corresponds more closely, in its horticultural demands, with the eastern parts of the old world, and that when the Chinese Sand pear and the Chinese peaches and various plants were brought over, it was found they had better growth in this eastern part of the continent than those which were brought from western Europe. The Sand pear crossed with the Bartlett pear gave us the Count and several other varieties, which served to extend suddenly the

limited pear culture from southern Virginia away south into Florida, three, four or five hundred miles.

This problem of breeding is one in which there need be no question of jealous rivalry. It should be a friendly rivalry. The work is of such a nature that if we are all working on exactly the same proposition we will arrive at different results. Dr. Saunders might be breeding a wheat on this side of the road and you might be breeding one on the other. You would have your ideas and personality, and he would have his ideas and personality, and the result would be when your work was finally completed you would probably have one thing and he another, and probably your variety, if you had done your work carefully and successfully, would be good for one condition and his variety good for another condition, and there would be no conflict. We can simply enter the field with open hands, and ask everyone to enter the field and do all they possibly can.

Now, while the animal breeders have gone ahead marvellously in this work of breeding, I want to tell you, gentlemen, that they are going to come to the plant breeders after a while. We can handle thousands where they can handle ten. We are breeding races while they are breeding individuals. So that I say a great deal is dependent upon the plant breeders to-day. We have not only accepted in a large measure the laws that are used by the animal breeders, but we are largely establishing our own practice and custom.

I represent, in a measure, an institution similar to yours, which exists in the United States, of which you may have heard—the American Breeders' Association—which was formed not only for plant breeders, but for animal breeders. We trust that everyone of you, gentlemen, will become a member of that association. We are issuing now proceedings covering the last two years, and I think the various papers published there will be an important contribution to the subject of breeding.

The American Breeders' Association is not limited to the United States, or we hope it is not, and we have several of your members with us, and we trust we shall have a much larger membership.

ADDRESS BY THE HON. SYDNEY FISHER, MINISTER OF AGRICULTURE.

Let me, Mr. Chairman, commence by expressing my gratification at the gathering of the Canadian Seed Growers' Association. This is the second convention of any association of this kind that has occurred in Canada. The theme and object of this Association are probably quite new to the great mass of the people of this country. The work is only just beginning to take form and shape, and it will be, no doubt, a little while yet before the people of Canada will appreciate and understand to the full the importance of the work of this Association and the great profit which may, through its work, come to the farmers and the whole people of Canada.

Perhaps I have a little greater knowledge than most of my hearers of the way in which this work was begun. The people of Canada owe a great deal to Prof. Robertson. Several years ago, with his great knowledge of the agriculture of Canada, he saw the necessity for the improvement in the seeds which our farmers were using. He was fortunate enough to have the friendship, support and confidence of Sir Wm. Macdonald, a man of eminence, wealth, of wide, patriotic and good intentions for the benefit of his country. Through that, and through Prof. Robertson's initiative and organizing power, certain work in seed growing was started in Canada. That work was begun with the children in the schools. It has developed, until to-day there are a considerable number of men especially interested in the growing of good seed. For the purpose of organizing these men together and enabling them to work harmoniously,

in co-operation, and thus to have greater power and strength in the work, the Seed Growers' Association has been formed, and is now entering upon or a little more than entering upon its work. Prof. Robertson talked to me, as Minister of Agriculture, a good deal about these things, and I was greatly impressed with the opportunities and necessities of such work.

In the first place anybody who travels about our country and knows anything about farming must appreciate and understand fully two things in our Dominion: the first, that we can grow a great deal bigger crops than we do, and second, that we can grow a great deal better crops than we do. Now, the last proposition is the most obvious, and it is terribly obvious through the length and breadth of this country. One of the great reasons that we do not grow as good crops as we might is that we do not use as good seed as we should—in two ways not as good seed. In the first place, we do not always choose the best variety adapted to our conditions and location. Very frequently there are better varieties than those which we use; then, in the second place, we do not use as good a quality of seed as we might and ought to, in order to get the best results.

I am not going to say very much upon the question of breeding new varieties. I think this is a line apart from the growing of seed. It is a line of work that is of the utmost importance, a line of work in which I am glad to say that Canada has been doing quite a little, through the work of Dr. Saunders, of the Experimental Farm. He has been for many years breeding new varieties, and has attained a great measure of success. But the other matter of the choice of varieties for the particular farm or location, or the particular section or district of the country, is entirely in the hands of the farmer, as is also the choice of the very best quality of seed of those varieties for use in the sowing of our crops. I have not had an opportunity of studying this question very deeply, but I have been able to cursorily examine some little of what has been done in the United States and some little of what has been done in Europe, and I find that where careful attention is given and work done on this line, we have extraordinary results—results which the ordinary farmer could hardly believe could have been obtained. If the people of this country will study this question, if our experts and those who are taking the lead in the matter will study out this problem, and if the ordinary farmers of the country will follow the advice which can be given by the experts, I have every confidence, and fully believe that we shall obtain a result equal to the results obtained in other countries. And it is certainly time in Canada that this work should be done and these results should be reached.

I have been notably struck by some work that has been done, in the getting of good seed corn in the United States. The reports show very marked results. I suppose that particular plant may be a litttle more amenable and a little more easily worked than some other kinds, but still, I do not see any reason at all why we might not have equally good results with wheat and oats as have been obtained with corn in certain states of the Union.

We are very fortunate in this country, not only to have with us in a gathering such as we have to-night Dr. Webber, an eminent man from the United States, but also in the fact that through our proximity to the United States, through the fact that their condition and, in many cases, their climate is very similar to our own, and in the fact that the language in which their reports are given to the world is our own language, we are able to have the advantage in Canada of the work that is being done in these matters in the United States. We are always very glad indeed to receive visits from the eminent men of that country, though they do not come as frequently as we would like. We are always delighted to see them and welcome them here, and take all we can out of them when they come, but still we have to do the work for ourselves. Much as we resemble them in their conditions, still there are certain conditions and problems which are not quite common to both countries, and, therefore, it is important and necessary that in Canada, too, we should have a Seed Growers' Association, and work out these problems for ourselves. Then we shall be able to give the results of our own work, in our own conditions and in our own soils, to our own people. I am sure this Association will do that work. It has made a beginning. It has not

done a great deal yet, but it has made a first rate beginning, and, as time goes on, I am quite sure that the results will be commensurate with the importance of the subject, with the energy and activity and the enthusiasm of those who are taking the lead.

I have been so impressed with the importance of this work, that I have not hesitated to establish in the Department of Agriculture a Seed Division for the express purpose of dealing with this particular work of trying to educate the people throughout the length and breadth of the land, and trying to encourage seed growers to work out their problems in the best way, and to assist them in co-operation and in mutual help one with the other.

I was glad when the work of this Association in the department was taken up, discussed and decided upon. I was glad to authorize the setting apart of a certain sum of money which we thought sufficient assistance to the Seed Growers' Association for the current fiscal year. I hope the money thus set apart will be sufficient to accomplish the objects aimed at. In consultation with Mr. Clark, the Seed Commissioner of our department, we found that there was still more seed work to be done in the ensuing year, and we have set aside a much larger sum than before—$2,550— for this purpose, which money will be available for the work of the Seed Growers' Association in Canada. I am satisfied that no money will be more profitably expended for the benefit of this country. The sphere is one of sufficient importance to justify this expenditure. I am not at all an expert in these matters. I am glad to be able to say, however, that we have in Canada a few experts who have studied long and carefully these matters, and that these men's services, through the good fortune of my having them in the department, are available for the people of Canada. By reason of this, I can look forward with confidence to the next year's work. All over Canada, scattered about here and there, are farmers who have been taking up this subject, who have been dealing with it and working on it, who are in earnest and enthusiastic, and who are painstaking and careful, to say the least, as well as pretty well informed as to the way in which they ought to do this work. I believe, therefore, that the results will be satisfactory, and I trust that this meeting, while in one sense perhaps the final meeting of the past year, will be practically the opening of the new year, and that the work will go on successfully and prosperously.

SCOPE OF WORK FOR THE CANADIAN SEED GROWERS' ASSOCIATION

(By G. H. Clark, *Seed Commissioner.*)

The rapid strides that have been made during the last quarter century in acquiring a knowledge of plant life and how it may be made to better serve the purposes of man, have not been closely followed by the great body of people who make their living primarily from the cultivation of plants in the form of field, garden and orchard crops on over thirty millions of acres in Canada. Our leaders in research work have not been able to bring about a full application of the product of their work in a way to make for the improvement of crops.

In the production of crops, seed and soil are interdependent—'useless each without the other.' It does not require close observation to be convinced of the advantages to be derived from the intelligent feeding of live stock or the feeding of plants. The results are amply evident, and the profusion of illustrations that may be seen everywhere—many of them accidentally provided—are suggestive of the principles taught, and, as illustrations, they have had a wholesome influence in stimulating to a further application of those principles. That greater progress has not been made in the application of these principles on Canadian farms cannot be attributed so much to lack of

understanding of the immediate results of such application as to the disinclination on the part of many farmers to do, at all times, that which they know best.

The benefits that are to be derived from the improvement of live stock and crops by breeding and selection are less readily apparent and seldom accidentally illustrated. They arise mainly through the continued intelligent application of far-reaching principles from generation to generation. A full measure of results is not obtained from a single action in any one year, and although the ultimate advantages from breeding and selection when applied to either animals or plants may be equally as great as those obtained from feeding and cultivation, the means for obtaining results are less attractive because they do not furnish quick and full returns from a single operation.

It is important that seed growers have a general knowledge of soils and the principles of soil treatment in its relation to the improvement of plants. In the production of high class seed, it is desirable that the various kinds of crops be provided with the environment and with plant food that will favour their development to the highest degree of perfection, and the dissemination of information relative to the principles of seed growing would be more complete if combined with instruction regarding the treatment of soil in its relation to the feeding of crops. This is a question which deserves the consideration of those who are concerned in advancing the interests of seed growers and the Canadian Seed Growers' Association.

The problem of formulating practical methods of applying the knowledge acquired from scientific research in the breeding and selection of plants and seeds, and encouraging their adoption on Canadian farms is one in which the Seed Branch is mainly concerned. In this our work is, and will continue to be, largely educational, and for the benefit of the people as a whole. The work of the Canadian Seed Growers' Association, at the organization of which our Department of Agriculture stood sponsor, may be expected to be fruitful of direct benefit first to the members of the Association—to the farmers who grow the seeds. Were such the only service that this Association might render, it would be well worthy of the support of those who are engaged in the production of high-class seeds as a means to advance their personal interests through organized effort, but the narrower object would scarcely command the co-operation and support of our leaders in agriculture and of parliament and other governing bodies. The scope of work for the Association, however, offers a much wider field for useful and attractive service. From the point of view of the Department of Agriculture, the organization of this Association was made necessary inasmuch as it is expedient that this branch of educational work may have the full support and be in accord with the common teachings of agricultural educators and be uniform throughout. By unitedly giving recognition to its objects, our leaders in agriculture, who are expected—in their advisory capacity as honorary members—to mould the workings of the organization, will do much to fix the keystone to the superstructure of future educational work that will make more certain the development, in geometric ratio, of the fruits of concerted action.

In the best interests of all concerned it would, in my opinion, be well, at least for some few years, for this Association to restrict its scope of operations to the general work as outlined in its original constitution, and in those operations to co-operate as best it may with the various other forces that are engaged in kindred work. The breeding of new and improved varieties of crops by cross-fertilization is a work that may, for the present, safely be left with experiment station experts. It is the privilege and duty of governments to provide liberally for the breeding and introduction of superior types and varieties of crops, and Canadian farmers are likely to continue to look to the Departments of Agriculture, through their experiment stations, for advancement from such a source. It should rather be the purpose of seed growers to make the best use of the seed provided from experiment stations by increasing its supply in its state of purity and productiveness, and to make further improvement.

The members of the Association will expect you to provide the means as soon as you may whereby they may, more conveniently, have a voice in the management of its affairs. They have a right to expect that, and the constitution makes provision for

the formation of branch associations on the authority of the board of directors of this central organization. The constitution also defines in general terms the duties and scope of work for the officers of this Association. It is now plainly evident to me that the time is not far distant when the work of the Association may become unwieldy, and too great for your secretary-treasurer to manage effectively in the best interests of the Association or of the producers and users of seed. It would be better then for the directors of the Association to make a division of the work that may be expected of your secretary, and look to branch associations to carry out such of your general plans and recommendations as may be more effectively managed at closer range. You may then learn of the desires of members through the media of branch associations.

This Association and its branch associations have a right to expect liberal support from the Dominion and Provincial Governments, through their Departments of Agriculture, so long as the operations of the Association be effectively directed in a way to attain its objects. It will require substantial grants from year to year, but more especially during the first few years of its work. You may be assured, too, that in considering applications for such grants, responsible ministers of agriculture will want some evidence that the funds thus supplied will be well and wisely used, as a means to attain the broader objects for which the Association was formed. As administrators they will be free to recognize those objects, but may not at all times be expected to approve of and support all the means used by the Association to attain them.

Seed growers should be expected to contribute, either as membership fees or otherwise, such amounts as may be found necessary and expedient to use in an organized effort to further their personal interests. The use of Association funds for such purposes as the issue of an annual catalogue of the seed produced for sale by members would be considered quite legitimate, and in the best interests of seed producers, of the Association and of persons desirous of obtaining high-class seeds; but even for so commendable a purpose it may not be considered good policy to supply money that belongs to the people as a whole.

In the continuance of its educational work the Seed Branch will look to the Canadian Seed Growers' Association for its co-operation and support. It will expect the Association to provide competent, trustworthy and energetic men to take an active interest in the direction and management of its affairs. The public will not expect that the educational policy of the Seed Branch will be directed with the one view to further the interests of your Association, although it might fully appreciate the fact that the best interests of both are inseparable.

The department may reasonably be expected to assist in protecting the interests of the public who purchase seeds, by examination, from time to time, into the operations of seed growers. That would also safeguard the best interests of the Association. The department in return will expect the members of the Association, individually and collectively, but more especially those who are entrusted with its government, to use the means at their disposal for stamping out any attempts at perpetrating fraudulent practices on the part of persons who may be admitted as members.

The records of the Association will mark the progress of improvement in farm crops throughout the agricultural districts of Canada. The objects in view are well worthy of the best efforts of men who are willing to undertake things that are difficult of achievement.

PROF. LOCHHEAD.—Mr. Clark says that if the Association grows it will probably be necessary to lessen the labours of the secretary-treasurer. It seems to me, however, that there must be a secretary at headquarters to direct the affairs as a whole and leave just as little as possible of the main work to the secretaries of the various local organizations. The records have to be kept at some central place and I think along that line it would not be wise to lessen the labours of the secretary-treasurer, but rather to increase his staff if necessary.

MR. CLARK.—I can see a great many ways whereby work may be taken up by the Association to the immense advantage of that body and of the local organizations throughout the country. One of the main reasons for organizing branch associations

would be that the members of the Association may have some convenient centres for meeting together for the purpose of disseminating information at closer range.

The CHAIRMAN.—I quite concur with what has been said as to the need that will exist, so far as one can see, for this Association in bridging over the gulf that still gaps between the knowledge, art and practice of the trained experimenter and research man, and the process of the ordinary farmer living in comparative isolation on his farm.

THE ACTION OF CERTAIN SMUT PREVENTIVES ON THE VITALITY OF WHEAT.

(By FRANK T. SHUTT, M.A., F.I.C., *Chemist, Dominion Experimental Farms.*)

BLUESTONE OR BLUE VITRIOL (COPPER SULPHATE).

Copper compounds have long formed the basis of our most successful fungicides; indeed, the history of fungicidal sprays for orchards and fruits and vegetables generally shows not only that one of the first mixtures to be successfully used against fungous diseases contained a copper salt as its essential constituent, but that to-day after years of investigation the copper compounds, and particularly the Bordeaux mixture, have few rivals in the control or destruction of these vegetable parasites.

It is not surprising, therefore, that Bluestone—a readily obtained copper salt—should have first been selected to combat the hard or stinking smut, commonly known as Bunt, which, uncontrolled, is apt to work so disastrously in the wheat fields of the North-west. The practice that has been so widely and for so many years in vogue is to treat the seed wheat, either by immersion or by sprinkling, with a solution of copper sulphate, the strength of the solution, the period of immersion, &c., being more or less determined by the degree to which the wheat is affected by smut. Thus, Mr. Angus MacKay, Superintendent of the Experimental Farm at Indian Head, Assa., and one who has had a long and successful experience in grain growing, says in his last annual report: 'For wheat apparently free from smut, one pound of bluestone dissolved in water and diluted to ten gallons is sufficient for ten bushels of wheat, sprinkling the seed or dipping it in the solution. For wheat at all affected one pound of bluestone in five gallons to five bushels of seed is required. The wheat can be sprinkled or dipped as is most convenient, but in sprinkling care must be taken that every grain is wet with the solution.'

Our attention was first drawn to this question of the effect of bluestone on the vitality of wheat in 1890 by the appearance in the North-west of 'agricultural bluestone,' a material cheaper than bluestone, and for which the claim was made that it was more efficacious as a smut destroyer and less injurious to the germ of the wheat. Analysis of the agricultural bluestone in the Farm laboratories showed it to have the following average composition:—

Sulphate of iron (green vitriol)	69·35
Sulphate of copper (blue vitriol)	30·65
	100·00

We then instituted a series of experiments (1) to ascertain the effect of solutions of iron sulphate, copper sulphate, and of the agricultural bluestone on the vitality of the wheat germ, and (2) to learn the relative efficiency of these solutions for the prevention of smut. These experiments were continued for three years in succession, the seed being treated and tested here as to vitality, and portions of the untreated wheat sent to the Experimental Farms at Indian Head and Brandon for results as to smut prevention. In presenting the data obtained, I shall as far as practicable give averages for the three years' work.

Experiment 1.—Red Fife wheat. Strength of solutions, one pound of material in eight gallons of water. Immersed for thirty-six hours, dried in the air and tested as to vitality immediately, and after a lapse of a fortnight, during which it was kept dry. 200 kernels were tested in each case.

	Percentage of Vitality.	
	Immediately on Drying.	After a Fortnight.
Untreated	97·5	96·5
Sulphate of copper	40·0	——
Sulphate of iron	86·5	86·0
Agricultural bluestone	64·0	55·0

By this treatment, i.e., thirty-six hours' immersion, it is seen that sulphate of copper (one pound in eight gallons) has a most deleterious effect on the vitality of the wheat germ; that the vitality of wheat treated in a similar manner with a solution of sulphate of iron (green vitriol) was but little affected (though the growth of the plants was at first retarded); that the solution of agricultural bluestone, similarly applied, had a decidedly injurious action on the vitality of the wheat—practically proportional to the percentage of copper sulphate it contained.

It is further apparent that during the fortnight after treatment and before testing, the sulphate of copper in the agricultural bluestone has had the effect of further lowering the percentage of vital seeds; the sulphate of iron had not, during this period, further impaired the vitality. Through an oversight, unfortunately, the data for the sulphate of copper were not preserved.

Experiment II.—Considering the method of treatment in the foregoing as extreme, I next determined to ascertain what the effect on the wheat germ would be by simply sprinkling the seed with the solutions (which were, as in experiment I., one pound to eight gallons), allowing them to dry and sowing at once. 200 kernels of the same wheat used in experiment I. were tested in each case.

	Percentage of Vitality.
Treated with Sulphate of copper	73·0
" Sulphate of iron	99·0
" Agricultural bluestone	80·0

A marked difference, due to the mode of treatment, is at once seen. The seed subjected to sulphate of iron had its vitality unimpaired; that with the agricultural bluestone lost 19 per cent of its vitality; while that with sulphate of copper was destroyed to the extent of 20 per cent. The length of time that the sulphate of copper solution is in contact with the seed undoubtedly determines to a very large extent the amount of damage to the vitality of the germ.

Throughout the above experiment it was noticed that the plants from the seed treated with the different solutions, and especially in Experiment I., had their growth retarded and weak as compared with those from the untreated seed, and this was much more marked when the grain had been subjected to solutions of copper sulphate and of agricultural bluestone than when sulphate of iron alone was used. As soon, however, as the roots had begun to absorb nourishment from the soil the lack of luxuriousness of growth was less noticeable, and after a short time entirely disappeared.

The treated wheats in Experiment II. were sown to ascertain the relative efficiency of the solutions for the prevention of smut, but no indicative results were obtained, as all the plots were free from smut, including that of the untreated wheat.

A parallel experiment, using Ladoga wheat, likewise gave no data as to hard smut or bunt, but loose smut appeared on all the plots, the percentages of diseased ears from the treated and untreated grain being very close. This experiment seemed to indicate that none of the solutions tried are efficacious in preventing the development of loose smut.

Experiment III.—In the season following, the work already outlined in Experiment II. was repeated. The solutions were copper sulphate, iron sulphate and agricultural bluestone, each of the strength of one pound to eight gallons. The treatment was merely sprinkling the grain with the solution under trial, and allowing it to dry spontaneously.

The wheats used were Red Fife, White Fife, White Connell, Judket and Ladoga. The results as to the effect on the vitality of the wheats are presented in summarized form in the following table:—

	Percentage of Vitality.
Untreated	89
Sulphate of copper	74
Sulphate of iron	86
Agricultural bluestone	85

Though the differences in the percentages of vitality are not in some instances so marked as in the previous year's work, the results on the whole are corroborative of those of Experiment II. Sulphate of iron and Agricultural bluestone had but little ultimate effect upon the seed when used as explained and of the strength given.

The retarding effect on the germination and growth of the young plant by treatment with these solutions was again made evident. This was most marked in the case of copper sulphate, and least in that of iron sulphate. The 'Agricultural Bluestone' occupies a position between the two, evidently fixed by the proportion of copper it concontains. As already remarked, the plants from treated seed became vigorous and robust after the roots had assumed their functional activity.

The grain, treated and untreated, was sent to the Experimental Farms at Brandon and Indian Head, where three ounces of each were sown on plots containing one hundred square feet, and the good and smutty heads counted before harvesting. Eliminating those varieties which showed no smut on the untreated seed plots and averaging the results of the others, we obtained the following data:—

	No. of Smutty Heads on 100 square feet.		
	Red Fife.	Judket.	White Fife.
Untreated	164	49	10
Sulphate of copper	1	1	0
Sulphate of iron	168	38	2
Agricultural bluestone	7	0	0

The efficiency of copper sulphate as a smut preventive is here well emphasized; at the same time it will be noticed that sulphate of iron is practically valueless for this purpose.

The third season's experiments comprised trials with solutions of the same character (one pound to eight gallons), as in previous years, contrasting sprinkling with immersion for five minutes and ascertaining the effect on the vitality of the germ and the prevention of smut.

In the case of the 'Agricultural Bluestone' and copper sulphate, duplicate quantities of seed after treatment were dipped in lime water. It was hoped by this means that the injurious action of the salt of copper on the germ would be neutralized without impairing its effect as a fungicide.

As in the foregoing trials, the treated wheats were sent to the Experimental Farms at Brandon and Indian Head.

The wheats under examination were Red Fife and Saxonka. Two hundred kernels were used in each case, and the seed immersed for five minutes, then spread out to dry and immediately tested for vitality. The average results as to the effect of the various treatments on the vitality of the grain are as follows:—

	Percentage of Vitality.	
	Thoroughly Sprinkled.	Immersed for 5 minutes.
Untreated	96	93
Sulphate of copper	79	77
Sulphate of copper and lime water	89	86
Sulphate of iron	91	90
Agricultural bluestone	90	90
Agricultural bluestone and lime water.	97	94

Summarizing our conclusions, we may say:—

1. That the copper sulphate, used alone or with iron sulphate (as in agricultural bluestone) lowers the percentage of vitality, and this corroborates previous results.

2. That the subsequent immersion in lime-water of wheat treated with copper solution lessens the injurious effect of the latter upon the vitality of the germ.

3. That the iron sulphate, as in previous experiments, does not as a rule affect the vitality of the wheat.

4. The differences between the wheats 'thoroughly sprinkled' and 'immersed for five minutes' are very slight; we may consider those methods as equivalent as regards their effect upon the vitality of the seed.

The reports received from the Brandon and Indian Head farms may be summarized in the following sentences:

1. That sulphate of iron is not efficacious in destroying smut spores.

2. That the sulphate of copper treatment is the most effective of all experimented with in preventing the development of smut.

3. That agricultural bluestone occupies usually a position between these two salts in reducing the amount of smut.

4. That the subsequent immersion in lime-water of seed treated with solutions of copper sulphate and agricultural bluestone lessens the effect of these compounds as smut preventives, and is not therefore to be recommended.

Our advice, therefore, has been: thoroughly sprinkle or immerse for five minutes the seed wheat, using a solution of bluestone (copper sulphate), one pound to eight gallons. Dry the seed, and sow as soon as possible.

In the foregoing we have made no attempt to arrange the voluminous data that have accumulated from investigations carried on simply to ascertain the efficiency of bluestone for the prevention of smut. For many years such trials have been made on the Dominion Experimental Farms, and especially at Indian Head and Brandon, and the results are to be found in the annual reports of the superintendents of those farms.

Formalin (40 per cent Solution of Formaldehyde).

The use of formalin in the treatment of grain for the prevention of smut is, comparatively speaking, a recent matter. The first employment of it for this purpose by the Dominion Experimental Farms was in 1898, three varieties of oats, all badly affected, being selected for the test. The strengths of the solutions experimented with were 3 ounces to 10 gallons and 4½ ounces to 10 gallons, or stated otherwise, 2 in 1000 parts and 3 in 1000 parts. The period of immersion or soaking was at first two hours, but it was subsequently found that this time could be very materially reduced without lessening the efficiency of the treatment. The results obtained on all the Experimental Farms were most satisfactory, so much so indeed that at the close of the season's work the superintendents at Brandon and Indian Head reported that they could confidently speak in the highest terms of this preparation for the prevention of smut in oats, when used at a strength of 4½ ounces to 10 gallons, the treatment being either thorough sprinkling or immersion for five minutes.

Following these initiatory trials, more extensive experiments have been made from year to year on the Experimental Farms, not only with oats but also with barley and wheat. Certain of the results go to show that the efficiency of the treatment as regards oats, at all events, increases with the length of the period of immersion as well as with the proportion of formalin used. On the other hand, in the majority of instances, thorough sprinkling or immersion for five minutes has proved as effective as two hours' immersion; and, further, save with very badly affected grain, results have been as satisfactory from 3 ounces per 10 gallons as from the stronger solution of 4½ ounces per 10 gallons. No doubt the character of the kernel and the extent to which it is affected are more important factors in the case of oats than in that of wheat or, possibly, barley. It is not our purpose here, however, to speak further upon this aspect of the subject—the data which have afforded the basis for the very high opinion we have formed of this

smut preventive, especially in the treatment of oats and barley, are to be found in the reports of the Experimental Farms for the past six years.

Our work with reference to the effect of the formalin solution on the vitality of the wheat germ was prompted by inquiries received this spring from the North-west regarding formalin which had become milky or partly solidified by age. In the first place, had such formalin lost its efficacy, wholly or in part, as a smut destroyer, and secondly, did such altered (polymerized) formalin injuriously affect the germ? To obtain data on these points two samples of wheat (Red Fife) were selected from the crop of 1902 and 1904 respectively. These were treated as detailed in the following table, and at once tested for vitality:—

ACTION OF FORMALIN ON THE VITALITY OF WHEAT.

Red Fife: 'A' crop of 1902, 'B' crop of 1904; immersed five minutes, dried and tested at once:

	Percentage of Vitality.
A—Untreated	92
B "	100
A—4½ ounces formalin to 10 gallons (normal)	70
B " " "	86
A " " (polymerized)	71
B " " "	95
A—9 ounces formalin to 10 gallons (normal)	72
B " " "	73

First, it is to be noticed that as in the case of the bluestone treatment, the formalin solution lowers the percentage of vitality. In one instance the stronger solution (9 ounces to 10 gallons) had, apparently, not affected the vitality of the wheat to any greater degree than the weaker solution. With the other wheat, however, the case was very different, and we find a considerable falling off in vitality due to the stronger formalin solution. Further work is necessary to establish the truth on this point, but most probably it will be found that the stronger the solution the greater the effect on the germ.

The same unsatisfactoriness is to be noticed in the results from the altered or polymerized formalin, and this work must be repeated before anything very definite can be said, though it is anticipated that this altered formalin will be found to be less injurious to the germ, and possibly less effective in preventing smut development.

Samples of all these treated grains are being grown this year at the Experimental Farms at Ottawa, Brandon and Indian Head, in order to ascertain the relative values of the various formalin treatments in smut prevention. We have also preserved samples of these treated wheats in order to ascertain their vitality from time to time, and thus obtain data that may be useful in establishing what we might term the 'after effect' of formalin on the wheat germ.

For the data in the two concluding tables presented in this paper I am indebted to Dr. Charles E. Saunders, Cerealist, Experimental Farm, Ottawa.

The first set of results compares the effect of bluestone, one pound to 4 gallons, with that of formalin, one ounce to 3 gallons, on wheat—the grain being dipped and immediately dried. The test was made one week after treatment.

ACTION OF FORMALIN AND BLUESTONE ON VITALITY OF WHEAT.

Vitality test made one week after treatment—dipped:

	Percentage of Vitality.
Colorado—Untreated	86
" Bluestone, 1 lb. to 4 gallons	75
" Formalin, 1 oz. to 3 gallons	95
Red Fife—Untreated	97
" Bluestone, 1 lb. to 4 gallons	90
" Formalin, 1 oz. to 3 gallons	93

In the case of the Colorado wheat the results are somewhat extraordinary ; the vitality was lowered by the bluestone treatment, as in previous experiments, but *apparently* increased by the formalin. We may feel tolerably sure, however, that formalin has no such action, but that it so happened that the sample of the untreated grain used in the vitality test did not represent the mass of grain treated.

The results from Red Fife are more in accordance with those of previous trials, though neither treatment has been so severe upon the germ as might have been anticipated.

In the following table the 'after effect' of formalin is well brought out, the vitality of wheat, oats and barley being ascertained eleven months after treatment. The data are of an exceedingly interesting and valuable character.

ACTION OF FORMALIN ON VITALITY OF WHEAT, OATS AND BARLEY.

Strength of solution, 9 ounces to 10 gallons.
The grain was between 2½ and 3½ years old when tested.

	Percentage of Vitality.
Preston wheat—Untreated	75
" Treated, vitality tested 11 months after treatment	0
Abundance oats—Untreated	62
" Treated, vitality tested 11 months after treatment	2
Royal Barley—Untreated	71
" Treated, vitality tested 11 months after treatment	3

It is clearly evident that formalin, like bluestone, *continues* to act disastrously upon the germ, for in the course of eleven months the vitality of these treated grains was entirely destroyed. This emphasizes the conclusion that all treated grain should be sown as soon as possible after treatment.

PROF. ZAVITZ.—Should the formalin be washed from the grain in any way before it is sown? If you treat the wheat and sow it at once would the formalin have any injurious effect?

PROF. SHUTT.—It undoubtedly has an injurious effect. I have not tried washing the grain. No doubt it would lessen the injurious effect, but I would not care to advocate that because I do not consider it practicable in the North-west. The great objection to the method in the first instance was the two hours required for the treatment. They wanted to sow it at once, and it so happens that it is better for the wheat to do it that way. The effect of the formalin is immediate, and it is best to get the grain into the soil as soon as possible.

The CHAIRMAN.—What is the reason for using this very strong solution of 9 ounces per gallon?

PROF. SHUTT.—That is when the grain is very smutty.

The CHAIRMAN.—Did not the weak solution give equally good results?

PROF. SHUTT.—While in the majority of cases as good results have been obtained from three ounces as from nine, still there have been instances of very smutty grain of certain varieties where better results followed the use of the stronger solution.

MR. SMITH.—Would there be any difference in the effect on the vitality of the seed if the bluestone and lime-water had been mixed before application?

PROF. SHUTT.—That is practically what was done by immediately soaking the seed in lime-water. The vitality was thus brought up to that of the untreated seed. Therefore, treateing seed with Bordeaux mixture does not materially affect the vitality of the seed.

MR. SMITH.—And does destroy the smut germs?

PROF. SHUTT.—No, it does not. The results are against it so far as smut prevention is concerned. Our results are against the use of lime when the object is to destroy smut.

Mr. BATHO.—I understand from some druggists that if formalin is kept for some time the strength of the solution in the bottom of the vessel is considerably greater than at the top.

PROF. SHUTT.—We have tested a good many formalins. If there is no milky appearance, I do not think there is any separation into layers of different strength. In uncorked or open vessels formalin, of course, loses strength.

Mr. KIRKHAM.—Should not the wheat be well covered up with sacks after it is treated?

PROF. SHUTT.—If the action of the formalin is immediate, as it would appear, the grain should be dried as soon as possible. Once the grain has been thoroughly wet, that is sufficient.

INSECT AND FUNGOUS ENEMIES OF CEREAL CROPS, AND THEIR TREATMENT.

(By PROF. LOCHHEAD, *of the Macdonald Agricultural College, St. Annes.*)

The insects and fungi affecting our cereal crops levy a heavy toll of many millions of dollars every year. The farmer is usually content to suffer in silence, and to pay this toll uncomplainingly; but when the exaction becomes very heavy he is roused to action, and to demand help from the scientific workers. During an average year, it is computed, the losses to cereal crops amount to more than ten per cent.

It is not my purpose in this short paper to describe the life histories of the chief insect and fungous enemies of the cereal crops, but rather to outline the best lines of treatment.

At the outset it may be stated that the plan or method of insect control on an ordinary farm devoted to cereal crops is quite different from that which is adopted on a fruit farm. It will be clear to all that the chief injurious insects of the farm, viz., the wheat Midge, the Hession Fly, the Wireworm and the Clover Seed Midge, cannot be controlled by applications of paris green, kerosene emulsion or soap solutions,—the plan under present conditions being impracticable. *Cultural methods* are employed almost entirely, and by such we mean 'some mode of culture or handling the crop which fatally interferes with the development of a given insect pest.' It would simplify matters very much if the farmer could control his insect and fungous pests by spraying, as does the fruit-grower, but, as a matter of fact, he must put forth greater exertions, he must be more alert bodily and mentally, he must possess a greater knowledge of the habits and life histories of the insects he wishes to control, and he must look ahead and consider the effect which any given procedure will have upon the insects.'

Let us see what are some of the cultural methods which are usually effective and are adopted by our best farmers:—

1. *Clean Farming.*—This involves the destruction of plant refuse and weeds which allow the insects to multiply. Many injurious insects pass the winter in dead stalks, under plant refuse, and in weeds and old fence corner sod land, and it is very important that all such plant waste should be destroyed, by fire, or other means.

2. *High Culture.*—'It is a well known fact that vigorous, healthy growing plants are far less liable to attack, and are far more likely to recover from injury, than those that are in any way weakened in vitality from lack of fertility or by neglect. Therefore if a farmer and gardener gives special attention to the fertility and drainage of his land, procures the best seed, and by proper planting and cultivation secures vigorous plants from the start, and by proper care endeavours to keep them in this condition

until the product is matured, he will have accomplished more in preventing loss from insect depredations than he would accomplish by the best remedies known applied to half-starved, neglected plants.' (Hopkins and Ramsay.)

3. *General Farm Management.*—Under this head comes *rotation of crops,* which is perhaps the most important single factor for the control of farm insects. Where short rotations are adopted unfavourable conditions are furnished the *white-grubs, wire-worms, root aphids, wheat straw worms* and *Hessian fly.* The general plan is to change the crop so frequently that it becomes impossible for any insect to pass through its life stages without being seriously disturbed, and its food supply destroyed.

Under general farm management will come also *time and method of plowing, time of planting,* and *harvesting,* all being important factors at critical times. Deep fall plowing is the only means we know of to control *wireworms* and *white-grubs,* and is effective against locusts, cutworms, army worms and wheat midge. With regard to time of planting, early planting is advocated for the wheat midge and late planting for the Hessian fly.

Early harvesting of clover is the only effective means of controlling the Clover Seed Midge and of securing a supply of clover seed on second crop. Chaff and screenings of infested wheat fields should be destroyed at time of threshing.

So much then for cultural methods of controlling the insects of the farm. Let us deal specifically with some of the most injurious forms.

The Wheat Midge.—This insect has not been so destructive in recent years as in former years, when the losses were enormous. The general adoption of rotation of crops and fall plowing have perhaps been the chief factors in its control. The deep plowing of old wheat fields buries the larvæ so deeply that the adult flies are unable to make their escape. The remedies are altogether preventive.

The Hessian Fly.—The remedies here are purely cultural,—(1) the preparation of a good seed bed, (2) the planting of the seed as late as local conditions will allow, (3) the planting of early trap crops, (4) co-operation among the farmers, and (5) the destruction of screenings at time of threshing.

Wireorms and White-grubs.—These grubs are the larvæ of beetles, and require two or more seasons to reach maturity. They do a great amount of injury by feeding on the roots of grasses and cereals. No effective remedy has been found, but fall plowing will do much to reduce their numbers. Where land is not allowed to remain longer than two years in grass or sod, there is little danger that these grubs will multiply. A systematic rotation of crops and the breaking up of grass land at the end of the second year will control them.

The Clover Seed Midge.—The reddish maggots of this midge become full-grown about the 15th or 20th of June in normal years, when they drop to the ground and pupate. To kill these maggots before they reach the ground is the problem to solve. This may be done by pasturing the clover until the 25th of June, and then securing a late crop of seed, or by cutting the clover for hay before the maggots have left the heads, and securing a late crop of seed as before. A little observation and judgment is necessary to determine the best and safest time to pasture or cut the clover, as differences will arise from year to year, according to season and latitude.

The Clover Root-borer.—In some districts the ravages of this little beetle prevent successful clover growing. Where these insects are numerous the best plan is to plow down the clover after one year, and devote the land to other crops.

Weevils of Stored Grain.—Occasionally these insects do considerable damage, especially when grain is held over from one year to another.

Treatment for these insects is comparatively simple, and consists in the use of carbon bisulphide (one pound to every hundred bushels). If the bin can be made tight, the treatment may be carried out in the granary. The liquid carbon bisulphide is poured into a jar or basin placed on top of the grain. Blankets or oil cloths are then thrown over the grain and the whole left for 36 or 48 hours. The liquid changes into gas quickly, which settles down into the grain and kills the weevils. The same method is used to kill pea-weevils.

Hydrocyanic acid gas is sometimes used in mills, and is very effective.

When we come to the fungous diseases of cereal crops, we find comparatively few of importance. Two diseases, or rather classes of diseases, however, stand out prominently and demand consideration—the *smuts and rusts.* From a practical standpoint all the varieties of smut may be considered together, although there is much difference in their habits. The damage done every year by the smuts on our cereal crops is enormous, and may aggregate several millions of dollars. Fortunately we have now two or three almost perfect remedies, which are very easy of application. The best known treatment is the bluestone treatment, which consists in sprinkling the grain prior to planting with a solution made by dissolving 1 pound of bluestone in 25 gallons of water. Some western wheat-growers immerse the grain first for 10 or 12 hours in a 1 to 25 solution, then for 5 or 10 minutes in lime-water (1 pound of lime in 10 gallons of water). The latter immersion is often omitted.

The formalin treatment is rapidly superseding the bluestone treatment, as the solution is more readily prepared,—1 pint of formalin is dissolved in 25 to 40 gallons of water, and the seed may be either immersed or sprinkled.

With regard to the *rusts of cereals,* we must confess that we have no remedial treatment. The presence of barberry in the immediate neighbourhood of grain fields appears to intensify the rust and to increase the loss, but the absence of barberry does not mean the absence of rust. It would appear to be advisable to use as seed grain obtained from fields free from rust, to avoid excessive use of nitrogenous manures, such as barnyard manure or nitrate, to develop rust-resistant varieties of wheat, as has been done with considerable success in Australia; to avoid planting barberries; to drain the land thoroughly; to avoid the use of manure obtained by feeding stock rusty straw, and to burn or plow down the rusty stubble before seeding, where such a procedure is practicable, as in the west.

DISCUSSION ON PROF. LOCHHEAD'S PAPER.

PROF. ZAVITZ.—I think in some places there has been trouble with an insect working on the corn. It would be well if we had a few words from Prof. Lochhead with reference to that insect.

PROF. LOCHEAD.—My attention was first called to it by a paragraph in the paper on Monday. It appears that some corn-growers were very much alarmed. They found many of their cornstalks affected with the cornstalk borer. The eggs are laid on the young plant and the caterpillars bore into the stalk and tunnel it. They usually bore downward. By August they will reach the root, and will change into pupa and remain all winter in the stalks. Then early next spring the moths come out again. There is no way of treating these things directly. It all lies in the line of prevention again, inasmuch as the caterpillar lives within the stalks. It is a very common practice in many corn districts to leave cornstalks out all winter after pulling the cobs, and of course it is a very common practice to leave the stubble, as they call it, out all winter. This could be prevented, and I should advise the corn-growers to take some action this fall and plow as much of the corn stubble as possible and destroy the pupa.

CORN BREEDING IN THE CORN BELT.

(By Prof. L. S. Klinck, *Macdonald Agricultural College, St. Anne's Que.*)

The leading corn-producing states in the Union are eseentially agricultural states. Their wealth lies in their soil. Directly dependent upon their soil is the industry of grain production. In grain production 'corn is king,' and in corn production a prime factor is well bred seed.

The importance of good seed is recognized to-day as never before. The past decade has witnessed an almost phenominal increase in the value of farm lands in these states. The appreciation in land values has rendered improved methods in crop production imperative. Methods of ten years ago no longer bring profitable returns for the time and energy expended. The area capable of producing corn in a commercial way cannot be materially increased, and the farmer is confronted with the problem of how to produce more bushels to the acre. Not only must larger returns be secured from an acre, but more attention must be given to quality as well as quantity. Methods of cultivation and harvesting have been greatly improved, but as yet comparatively little attention has been paid to the selection and breeding of the seed planted.

The tendency in recent years has been in the direction of smaller farms and more intensive cultivation. This is a necessity growing out of the new conditions. With a fertile soil and with every modern facility to lessen the labour incident in corn production, the average yield of corn for the past ten years in the seven leading corn-producing states in the Mississippi valley has been nearly nine bushels to the acre less than the yield obtained on the stony hillsides of the New England states, where flint varieties are grown almost exclusively.

This marked difference in yield is due, not to better soil conditions, but to more intensive methods of culture, and to stricter attention to the selection and breeding of the seed planted.

The past two years have witnessed a wonderful awakening of interest in these states in the production of more and better corn. Farmers are no longer content simply to grow 'corn' without regard to purity, type or quality, but are securing those varieties which combine yield and the highest percentage of constituents most valuable for their particular purposes.

The work of Dr. Hopkins, in Illinois, in improving the chemical composition of corn, and the work of Prof. Holden, of Iowa, in selection, has awakened a great interest in this much neglected cereal. The methods for improvement, while scientific, are simple, and the farmers have been brought to see that with very little additional labour, and with practically no expense, they can materially increase their profits by increasing the quantity and improving the quality of their corn crop.

The work in corn improvement as carried on by these men has been productive of wonderful results. No new varieties have been originated, as one of the great difficulties now encountered in corn improvement is the lack of fixity of type, and a consequent tendency to wide variation. Their object was not to add another variety to the already overburdened list, but to improve an established variety already possessing desirable characteristics in a marked degree, and by breeding, render it still more efficient for specific uses and adapted to special localities.

In Bulletin 82 of the Illinois Experimental Station, Dr. Hopkins gives the following reasons for breeding corn for specific purposes:—

'It is a well established fact that there now exist markets and demands for different kinds of corn. The price of corn varies, say, from one-half to one cent per pound.

'The cost of protein in the principal stock-feeding states varies from three to five cents per pound. In other words, the protein is several times more valuable per pound

than the corn itself. Consequently, stock feeders want more protein in corn. (Very possibly the feeders in the southern states want more carbo-hydrates to supplement their present more abundant supplies of nitrogenous food stuffs.)

'The price of corn starch varies from two to three cents to five or even ten cents per pound, depending upon the wholesale or retail nature of the sale. The manufacturers of starch and of glucose sugar, glucose syrup, and other products made from starch want more starch in corn.

'In its own publication, a large commercial concern, which uses enormous quantities of corn, makes the following statements:

"A bushel of ordinary corn, weighing fifty-six pounds, contains about four and one-half pounds of germ, thirty-six pounds of dry starch, seven pounds of gluten and five pounds of bran or hull, the balance in weight being made up of water, soluble matter, &c. The value of the germ lies in the fact that it contains over forty per cent of corn oil, worth, say, five cents per pound, while the starch is worth one and one-half cents, the gluten one cent and the hull about one-half cent per pound.

'It can readily be seen that a variety of corn containing, say, one pound more oil per bushel, would be in large demand.

'Farmers throughout the country do well to communicate with their respective agricultural experimental stations, and secure their co-operation along these lines.'

These are statements and suggestions which should, and do, attract the attention of experiment station men. They are made by the Glucose Sugar Refinery Company, of Chicago, a company which purchases and uses, in its six factories, about fifty million bushels of corn annually. According to these statements, if the oil of corn could be increased one pound per bushel the actual value of the corn for glucose factories would be increased five cents per bushel; and the president of the Glucose Refining Company has personally assured the writer that his company would be glad to pay a higher price for high oil corn whenever it can be furnished in large quantities. The increase of five cents per bushel on fifty million bushels would add $2,500,000 to the value of the corn purchased by this one company each year. The glucose factories are now extracting the oil from all the corn they use, and are unable to supply the market demand for corn oil. On the other hand, to these manufacturers, protein is a cheap by-product, and consequently they want less protein in corn.

'Corn with a lower oil content is desired as a feed for bacon hogs, especially for our export trade, very extensive and thorough investigations conducted in Germany and Canada having proved conclusively that ordinary corn contains too much oil for the production of the hard, firm bacon which is demanded in the markets of Great Britain and continental Europe.

'The methods of corn breeding devised by the Illinois Experiment Station and now used also by the Illinois Seed Corn Breeders' Association, and, to some extent, by other experiment stations and other corn breeders, have for their object the improvement of corn—in yield and in quality. In the main the methods are now the same as we have employed for the past six years, and they have given results which enable us to assert with confidence that by these methods corn can be improved in a very marked degree and for many different purposes. The yield of corn can be increased, and the chemical composition of the kernel can be changed as may be desired, either to increase or to decrease the protein, the oil or the starch.'

One of the three methods or a combination of two or more of these is generally employed in improving plants. First, selection; second, testing promising individuals for prepotency or reproducing power; third, crossing. Variation through crossing is sometimes induced in order to 'break the type,' and so obtain a wider field from which to select; but this is not necessary in corn, as the tendency to variation is already too great. This is, of course, to be expected, for with any open-pollinated plant so extensively grown, crossing, whether intentional or accidental, is sure to be effected.

If, therefore, an improved strain of corn is desired, the breeder will attain his object much more quickly by making his selection from a variety of acknowledged excellence, based on long years of rigid, systematic selection and adherence to an estab-

lished type. By pursuing this course the breeder will have the benefit of years of careful breeding behind him, there will not be the same lack of uniformity in type that there would be if he made a new cross, and while he will not have the same diversity of forms from which to select he can rest assured that the type selected as his ideal will be reasonably sure to transmit its characters.

As there are wide differences in the performance records of varieties, so there is a great range in the reproductive powers of different individuals in the same variety. Corn plants are infinitely variable. No two are exactly alike. Breeders now recognize the fact that each plant has an individuality and that improvement must come through the individual.

We frequently find a wider difference in the yield of two good ears of corn, which outwardly appear the same, than in two varieties having similar characteristics. This difference is not confined to yield alone, but manifests itself in the general character of growth such as height of stalk, structure of stalk, amount and character of foliage, height at which ears are borne, size and character of shank, number of barren stalks, broken stalks, suckers and the degree of resistance to the attacks of smut.

Since these characters are generally transmitted to the progeny, it readily can be seen that this tendency to variation becomes, in effect, the basis for improvement, not only between varieties but within a variety itself.

METHODS OF CORN BREEDING.

Three methods of breeding corn are commonly practiced,—the *farmers' seed block system,* the *block or mating system* and the *row system.*

The Farmers' Breeding Block.

For a breeder, situated as is the ordinary farmer, a simple and inexpensive method must be followed. The improvement of course will not be so marked as in the other methods, but this plan, if persistently followed, will do much to improve the yield and quality of any corn.

From the seed selected for planting pick out twenty or thirty of the choicest ears and plant them in a block by themselves on the south or west side of the field where they will be removed at least one-quarter mile from any other variety. These locations are to be preferrred, as the prevailing winds come from these directions. If corn of another variety is near enough to cause damage the choice ears may be planted in the middle of the regular field. Here they should receive close attention, as they are naturally placed at a disadvantage through being surrounded by, and more or less crossed with the ordinary field stock. If planted on the side of the field it is best to plant in a block, as a number of rows on one side are almost sure to receive too little pollen for complete fertilization if planted in a long, narrow strip. No special care need be given this plot in the way of manure or extra cultivation, as the conditions should be as nearly as possible those under which the corn is to be grown.

The thirty ears should be shelled together and planted the same as ordinary corn. This amount of seed should be sufficient to plant from two to three acres.

When the corn is tasseling out, and before any pollen is shed, detassel all weak stalks, barren stalks and suckers. As all stalks do not tassel at the same time it will be necessary to go through the block about three times, at intervals of two or three days, to make sure all undesirable stalks are detasseled, so their pollen will not fertilize the silks of good stalks, and predispose the kernels on a good ear to barrenness and production of nubbin-bearing stalks.

This method requires but a few hours extra work, and the results obtained in practice have more than justified the additional expenditure of time. One of the strongest arguments in favour of this system is that it enables the breeder to make a more intelligent selection of his seed corn in the fall.

Not only is he enabled to make a better selection both from the standpoint of ear and stalk, but it makes conditions more favourable for harvesting and storing his seed corn at the time and in the manner he considers will give best results. Since 'Like begets like,' he has reason to believe his best seed ears will be found in his seed block, because his best ears were planted there.

At the proper time for husking he can make a careful selection based, not only on the ear alone, but on the nature of the parent stalk as well. Naturally he will choose the largest and best developed mature ears borne at a convenient height on desirable stalks. Not only will this system tend to increase the probability of more careful field selection, but it will do even more towards improving methods of storing.

With a seed block a farmer will make a business of selecting his seed ears at the proper time instead of depending on getting choice ears from his entire field. One thing at a time is all a man is capable of doing well, and in the rush of regular husking seed ears are usually chosen because of size instead of paying due attention to the stalks bearing them, the character of the ground on which they were produced, the number of stalks in the hill, and other factors equally important which have a very direct bearing on the character of the ear produced.

THE BLOCK SYSTEM.

In the block system an ear possessing outstanding merit in one or more desirable characters is mated with an ear possessing other desirable features, but perhaps somewhat deficient in those points in which its mate excels. By mating these two ears the breeder aims at combining the desirable qualities of both parents in the resulting progeny.

In following this system the odd numbered rows are planted with the odd numbered ears. At tasseling time the progeny of one ear is detasseled to prevent inbreeding, and the breeding ears for next year's crop are selected from the detasseled rows.

While this system has its commendable features, it is open to a number of serious criticisms. The great amount of labour of harvesting and weighing each row by itself makes it almost impracticable for the average breeder except on a very small scale for foundation stock.

Another strong objection is the inability of the breeder to estimate correctly the effect of soil conditions on the yield of the different plots, for no matter how uniform the field may be, experiments have proven that the soil frequently has more to do in determining yield than the quality of the seed sown. In the plot system the soil is a more potent factor in determining yield than it is in the row system, because it must, of necessity, be small, and hence too often representative of the entire field.

In addition to these disadvantages, the breeder must bear in mind that unless he has each plot completely isolated the progeny of the detasseled rows will not be wholly the result of crossing between the mated parents, but will, to a considerable extent, be the result of crossing from stalks in adjoining blocks.

THE ROW SYSTEM.

When time and means are at the disposal of the breeder best results are secured by adopting the row system. By this method ears possessing the desired characteristics in the highest degree as determined by their conformity to the points which go to make up perfection in form, and also from the chemical composition as determined by analysis, are planted in rows by themselves. Each ear is shelled separately, and its kernels are used to plant a row. A composite sample is made of the corn remaining from all the ears, and this is used to plant several border rows around the block to protect the breeding ears from foreign pollen.

Before any pollen is shed, alternate rows are detasseled to prevent inbreeding. Barren stalks and suckers in all the rows are detasseled or removed to prevent their pollen fertilizing strong vigorous silks. At harvest time full field notes are taken in all de-

tasseled rows. These rows are then husked and weighed separately, and the choicest ears from those rows showing the greatest number of desirable characters are saved for next year's breeding rows.

This system makes it possible to obtain the performance record of each individual ear, and this record forms the basis for the selection of future mother ears. While this method makes it possible to ascertain the exact reproductive power of each ear it presents the usual possibility for self-pollination, and an unusual possibility for close-pollination.

In an experiment extending over four years at the University of Illinois, where alternate rows were detasseled and the best ears from the highest yielding rows in the tasseled and detasseled rows were planted successively, the average increase in yield for the four years was 10:6 bushels per acre in favour of the detasseled rows. Of course the detasseled rows were cross-pollinated, while the tasseled rows became more and more inbred.

These marked results in favour of cross-pollination led to the planning of an experiment to insure the greatest amount of cross-breeding. Each row was planted with corn from a separate ear. The even numbered rows were detasseled and seed for the next year's breeding plot was taken from the six best yielding detasseled rows in each quarter, four ears being taken from each row. Of the four seed ears taken from each selected field row, two were used for sire seed and two for dam seed. A guide system for even years and a guide system for odd years has been worked out whereby the ears are so planted in the field that practically no inbreeding occurs. As yet no data has been secured on this experiment.

After the four choice ears have been selected from each of the six best rows in each quarter of the breeding block, the remaining good ears are planted in the multiplying plot. Here all weak and barren stalks are detasseled as the seed for the commercial field is taken from the multiplying plot. All seed ears are registered, and the number and description of each ear, together with the performance record, is carefully preserved.

Since it has been demonstrated that the breeding of corn for specific purposes is both possible and practicable, a number of breeders and commercial seed houses have taken up the work with marked success. At Bloomington, Illinois, the Funk Brothers have over 8,000 acres in improved strains of corn. They have devoted considerable attention to, and are making specialties of, breeding corn high in oil and high in protein for general feeding; high in oil and low in protein for glucose factories; high protein, without changing the normal amount of oil to obtain a balanced ration for fancy beef and bacon hogs, and high protein with low oil for growing cattle and for young stock.

This firm has its own chemist and a thoroughly equipped chemical laboratory in Illinois.

Any corn breeder in the state (Illinois) may have several samples of his corn analyzed by the station free of charge, providing he carries on the breeding work as directed by the station.

The real work of breeding corn is as yet largely in the experimental stage. A few pioneers have, by their failures and by their successes, pointed out the way, but much yet remains to be done. Much of the so-called breeding of to-day cannot correctly be termed breeding. Much of the so-called pedigreed corn offered to the public is not really pedigreed corn. An absolute pedigree can be established on the dam side, but as near as we can come to the pedigree of the male side is that we are sure it is of good blood although the exact pedigree cannot be ascertained and recorded.

Mr. NEWMAN.—The percentage of barren stalks in the corn districts in this country is something which our people do not realize. In some plots we have found as high as fifty per cent of barren stalks, not suckers, but plants growing up and not producing ears of corn at all. Other places we have found as many as thirty per cent. People do not realize that if they have three stalks to the hill and one not producing corn that there is thirty-three per cent of the whole crop which is barren.

A MEMBER.—Although we do not use corn as largely as our friends across the line, still in certain parts of Canada corn is largely used for bacon production. The facts go to show that it is the oil in the corn that produced that softness which was so objectionable to the English consumers of our bacon. If we can materially reduce the percentage of oil in the corn, it seems to me there is an opening for very lucrative work in the production of corn on a large scale commercially.

PROF. ZAVITZ.—It seems to me that in connection with the Seed Growers' Association and in the matter of corn breeding a great advantage would be obtained in the corn selection from the educational work which would be carried on in connection with it. If we get specimens of corn specially grown in this province and find out the germination, we find that it will vary all the way from 5 to 95 per cent. I got several samples in which there was only 3 or 4 per cent of the corn that would grow at all, and the educational work that has been carried on in connection with corn will cause the people to take more pains, not only with the selection of the ears but the preservation of the corn, so we will get a much larger percentage of germination.

PROF. KLINCK.—The question of varieties adapted to certain districts is another fundamental principle. It will not do to bring corn from Missouri and southern Illinois to Canada. There is a wonderful field in western Ontario for a variety of corn adapted to different districts, and instead of a number of people sending over there to get corn in northern Ohio, as a matter of fact it is brought in carloads from Missouri sent up here, and you do not know where it comes from. For instance, a man obtains a certain variety of corn and it does remarkably well; next year he sends for the same variety and it is not satisfactory. That is generally due to the fact that it is brought from a different place—the same variety but a week or ten days later. That is not only the case with corn but, also with all our small grains.

Mr. BRIGGS.—Mr. Klinck has touched upon a matter that requires a little explanation. Possibly he may be a little astray in some of the remarks he makes in speaking of the seedsmen and the corn he gets from the seedsmen in Ohio. I do not know what seedsman he refers to, but I may say that whether Canada can be made a profitable district for growing seed corn is a matter requiring very considerable time for experiment, because, while we can grow fine samples of several varieties of flint corn, we cannot depend upon western Ontario corn for germination, and the reason for that possibly is that our climate is too damp and moist.

PEDIGREE OR GRADE BREEDING.

(By HERBERT J. WEBBER, *Physiologist, in charge of Plant Breeding Laboratory, United States Department of Agriculture.*)

WHAT IS MEANT BY PEDIGREE OR GRADE BREEDING?

In animal breeding it is generally understood that pedigree or grade breeding means the breeding from registered sires, and it is generally recognized that wherever breeding of this kind is carried on it is done very carefully. Grade breeding has come to be almost synonymous, as it were, with the use of care in selection. The breeder who takes the trouble and expense of registering an animal is very certain to give very careful attention to the characters of the animal, and to know that it is above the average before having it registered. While the practice of grade breeding is by no means universal among stock raisers, it is very much more general than among plant breeders. We have devised no means as yet of registering or pedigreeing plants in the sense in which such a practice is carried out with animals, and we therefore have no general breeding of plants under this system except in an experimental way. Ordinarily speak-

ing, it must be confessed that experimenters use very little care in the selection of corn, wheat or cotton seed. The selection and preservation of seed, it has seemed to the writer from experience in various parts of the country, is seldom given careful attention. Indeed it may be said that it is the exception to find farmers that really have any very definite method of seed preservation or selection. The most common practice with corn, certainly until recent years, was simply to select the best ears from the crib each spring to use as planting seed, growers thinking they could judge of the germinability and vitality of the corn by the appearance of the ear. In the case of cotton, growers almost universally take any seed that can be obtained without reference to character or quality. Some growers preserve the first or second pick of the crop and have it ginned separately, and preserve this seed for planting. On the other hand, a great many growers still take any seed which can be obtained from a public gin and about which they know absolutely nothing. In wheat also, as a general thing, very little care is exercised other than possibly to carefully screen it in order to get the largest and heaviest kernels.

The practice of pedigreeing stimulates care, advertises the grower's stock, and has proven so successful in animal breeding that it has been adopted by breeders of horses, cattle, swine, &c., in all civilized countries. The experiments of plant breeders have been carried far enough to demonstrate beyond a doubt that almost any strain or variety can be improved in yield or in quality by methods of careful selection and pedigreeing. Should we not, therefore, adopt standard methods of pedigreeing plants that can be readily practiced, and should we not also devise some means by which good pedigree strains may be registered in order to furnish the grower with a stimulation to careful work, and also furnish him with the protection and stamp of authority which is given by the pedigree record?

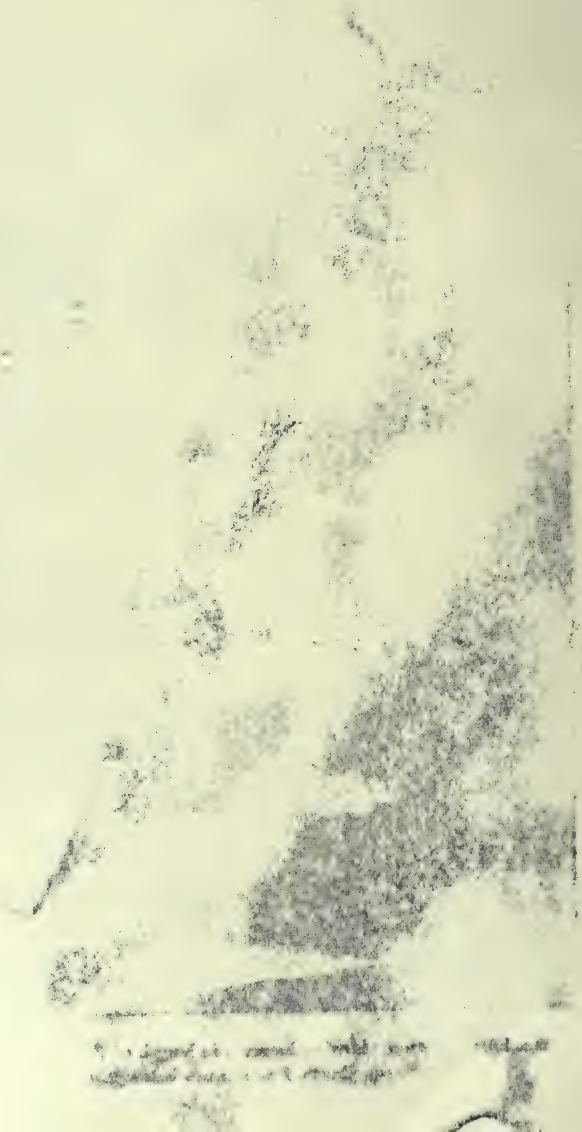
DIFFERENCE BETWEEN ANIMALS AND PLANTS.

There is a fundamental difference between animal and plant breeding which is seldom recognized. In animal breeding the production of new races or breeds is very rare. Ordinarily the improvement sought in animals is simply improvements in the same race or strain, such as increased size, or improved beef quality, milk quality, fecundity, &c. It is true that occasionally animal breeders produce new races or breeds, but this is very rare, and ordinarily the selection is carried on entirely within the race. Among plants, however, breeding as ordinarily understood consists in the production of new races or varieties. The plant breeder ordinarily does not consider that he has succeeded unless he has produced a new variety with marked taxonomic differences, so that it may be recognized as distinct from any other variety. These new races or varieties which the plant breeder produces correspond in degree of difference to the different breeds or races of animals.

This striving after markedly distinct varieties has led the plant breeder to overlook the very important improvements which might be wrought within the strain by grade breeding. The primary reasons for the differences that exist between animal and plant breeding is due to the different nature of the organism. Animal breeders are dealing with individuals of long life and very valuable. They can thus handle very few individuals. Plant breeders, on the other hand, deal with very large numbers. The majority of our agricultural plants are annuals and occupy but little space, so that an individual has but insignificant value. The plant breeder can therefore handle thousands where the animal breeder can handle only tens. The plant breeder has no means of registering or pedigreeing, but he does name groups or strains where the animal breeder registers individuals. Yet in both cases the breeding is governed by the same natural laws, and the improved strains of plants must refer back to an individual as definitely as in the case of animals.

Small plots or centgeners of Rye, each plot representing the progeny of a single plant selected the preceding year. (The product of each plot has been cut and the heads wrapped in cloth to prevent injury by birds. Phots of plants grown by Prof. W. M. Hays.

Sea Island Cotton, showing increase in length of fibre by selection. Four strands above from ordinary plants, four strands below from select plants. (Natural size).



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OBJECTS OF PEDIGREE OR GRADE BREEDING.

The objects of pedigree breeding are therefore twofold among plants: (1) the improvement of old races or strains, that is, the selection within the race without changing it, in order to secure some inherent or intrinsic quality of value, and this we may term strain breeding; and (2) the production of new races or strains differing from each other by some taxonomic character. This we may call race breeding. When we come to consider horticultural crops where we deal with many different plants that are propagated vegetatively by buds, cuttings, tubers, runners, &c., we have to deal with a different class of varieties, here the object being to secure a single excellent individual which possesses certain desirable qualities differing from those of any other individual. When this single individual is discovered, and it may be a hybrid or a mutation, it can be propagated indefinitely, and its offspring are in reality simply transplanted parts of the same individual. To clearly understand the character of organisms with which we are dealing we need careful definitions of our different groups of cultivated plants which are ordinarily known as varieties. We speak of varieties of wheat, corn, apples and pears, yet we all know that these varieties differ from each other as natural groups. In order to clearly distinguish these differences the writer has proposed the following classification of varieties into races, strains and clons. Under races we would classify those groups of cultivated plants having well marked, differentiating characters which propagate true to seed except for simple individual variations. The different groups of beans, peas, wheat, oats, corn, cotton, &c., referred to commonly as varieties, are thus in a more restricted sense, races. Boone County White, Leaming, Reid's Yellow Dent, &c., would be recognized as races of field corn; Turkey Red, Fulcaster, Fultz, as races of wheat.

Strains, the writer would recognize as groups of cultivated plants, derived from a race, which do not differ from the original of the race in visible taxonomic characters. When the breeder by a careful selection of Blue Stem wheat produces a sort of Blue Stem which differs from the original race only in the quality of yielding heavily, it would be called a strain of Blue Stem.

Clons are groups of cultivated plants, the different individuals of which are simply transplanted parts of the same individual, the reproduction being by the use of vegetable parts such as bulbs, tubers, buds, grafts, cuttings, runners, &c. The various sorts of apples, potatoes, strawberries, chrysanthemums, &c., commonly denominated varieties, in a more restricted sense would be clons. Clons of apples, pears, strawberries, potatoes, &c., do not propagate true to seed, while this is one of the most important characters of races and strains of wheat and corn. The term variety would thus be used in a general sense, and would include races, strains and clons.

In a strict sense pedigree or grade breeding would have to do with improvements within the race, that is, with the production of improved strains. In the breeding of new races or clons, however, selection would have to be carried out on practically the same basis, and there is thus no definite line of demarcation between pedigree or grade breeding and the breeding for the production of new sorts.

THE CAUSES AND USE OF VARIATIONS.

In pedigree or grade breeding the breeder is limited in the choice of variations more than in cases where he is attempting to produce new strains. Here the object is simply to improve old and reliable strains without breaking them up and inducing new characters. He should not expect to produce marked changes which would result in forming new races of doubtful value. Thus the work in this field is more certain of successful results. Indeed, as long as breeding is strictly within the race it would seem that there is no possibility of failure in obtaining valuable results providing the selections are carefully made. The breeder here is limited to those slight variations which are ordinarily recognized as individual variations or differences. Every farmer recognizes that if he carefully examines the different individual plants in a row of corn of

the same race, or of wheat, cotton or any other crop, individuals will be found to differ considerably. There will be slight variations in the length, diameter, and shape of the ears, length of the kernel, size of the cob, and other important factors that go to make up a good ear of corn. It is necessary that the breeder should clearly recognize what characters are most important, and select as mothers the individual plants which possess in the highest degree the character desired.

NECESSITY OF A CLEARLY DEFINED IDEAL.

Careful breeders have found it very desirable and necessary to have a clearly defined ideal type which they are striving to produce. In the selections within the race it is necessary that the breeder have all of the characters of the race which he is breeding clearly in mind, and the writer believes that all breeders should be recommended to carefully draw up a description of the type which they are breeding and the objects which they are attempting to attain; otherwise it is difficult to properly limit the selections. All breeders know that in growing a large number of plants for selection different types are liable to crop out here and there that appear very promising. We may be selecting for a certain type, and find in the row of plants which we are examining an individual which differs somewhat in its character but which seems to be of exceptional value. The temptation under such circumstances is to take this new plant and discard the old ideal. Many breeders have found to their sorrow that by taking such selections they have made serious mistakes, and lost the improvement already obtained. Whenever a plant of different character springs up it is entirely an unknown quantity, and may not transmit the desired characters, and even if it should these are different from the qualities of the ideal strain for which the selection first started is being made. One of the writer's experiments furnishes a very interesting illustration of this kind. A certain type of cotton hybrid had been under selection for several years, and had nearly reached fixity. In the fourth generation of the selection a few plants were found in an isolated field which were different from the old type with which the selection started, and seemed to be rather superior to it in having larger bolls. It also differed in having a leaf and stem flushed with red. This new type was selected and planted the following year. Observations on the progeny showed the plants to be exceedingly variable, practically the same as a second generation hybrid, and all of the time that had been expended in the preceding selection had thus been lost, the new type requiring the same amount of selection to bring it to stability. Fortunately in this case selections of the original type had been continued, so that nothing was lost other than the expense of the experiment. Such instances emphasize the importance of adhering strictly to the original type of the selection unless it is desired to start improvement along other and new lines.

CONTROL OF PARENTAGE.

In plant breeding, as in animal breeding, the isolation of the parents is a very important consideration. It is necessary that we should know the character of both parents wherever this is possible. In breeding plants more attention is ordinarily given to the mother plant, and in very many instances the characters of the father plant are entirely neglected. Animal breeders, on the contrary, give more attention to the characters of the male parent, and a great deal of improvement in ordinary herds is accomplished by the introduction of improved blood through the male. In plant breeding it is desirable that the seed of the select individuals be planted in a field by themselves. This insures that only progeny of carefully selected plants will be planted near together, and thus no ordinary stock will enter in as a contamination. One can be certain that each plant of the progeny is fertilized with pollen from another similarly good plant, or at least from a plant derived from good parentage. One difficulty, however, has been experienced by plant breeders in planting continuously their selected stock in such isolated plots. If this method is continued year after year, it results in

fairly close inbreeding, which in the case of plants frequently results in loss of vitality and vigour. In animal breeding it is apparently the case that ordinarily there is no noticeable effect from close inbreeding, and many of the most famous animals have been produced as a result of the closest in and inbreeding. In plants, however, it is possible to secure much closer inbreeding than in the case of animals, as in many cases a plant can be fertilized with its own pollen.

Within recent years much activity has been shown in the careful breeding and improvement of corn. The corn plant has been shown, as a result of experiments carried on by various investigators, as, for instance, the Illinois Experiment Station and by the Department of Agriculture, to lose vitality very rapidly when self-fertilized. Within three or four generations by the most careful inbreeding it is possible to produce a strain of corn of almost total sterility. The general practice of corn breeders who have been giving attention to the production of pedigree strains is to plant the rows of corn from different select ears side by side, giving a row to each select ear, and each year selecting from the progeny of those rows which give the largest yield further plants to continue the selection. Planting these select ears together every year, therefore, means that they are more or less inbred as the closest relatives are planted together in the same row. While in following this policy at first no effect was visible, corn breeders are now finding in some cases an apparent decrease in yield, which seems to be traceable to the effect of inbreeding. It, therefore, seems necessary for us here and in other plants that are effected by inbreeding to devise some methods that will avoid close inbreeding. Methods for the use of corn breeders have been described by Prof. Klinck before this Association, and do not need repetition. The detrimental effect of inbreeding is largely limited to those plants which are normally cross-fertilized, this fact being strikingly brought out in Darwin's famous 'Investigations on Cross and Self-fertilization in the Vegetable Kingdom.' Tobacco, wheat, and some other plants which are normally self-fertilized do not show this decrease in vigour as a result of inbreeding. Indeed, in such plants cross-fertilization ordinarily results in decreased vigour, and should be avoided.

SYSTEMATIC METHODS OF PEDIGREE BREEDING.

Probably the majority of the members of this Association are familiar with the methods of selection ordinarily pursued. Two distinct methods are in use, which are termed, (1) nursery method and (2) the field method. The nursery method, which was used first by Hallet about 1868, so far as the writer is informed, consists in cultivating each plant under the most favourable conditions possible for its best development. By this method, with wheat, for instance, Hallet pursued the policy of planting the individuals in squares a foot apart, which would give the plant abundant opportunity for stooling, and also the investigator to clearly distinguish each individual plant. In more recent years this method has been strikingly emphasized by the work of Professor Hays, at the Minnesota Experiment Station, who has, at the same time, modified the principle somewhat into his centgener method.

The field method, which was used by Rimpau about 1867, consists in selecting from plants grown under normal conditions. The claim for this method is that the plant will only show what it will do and its true worth when it is grown under the method of ordinary field culture. Rimpau's method was used successfully in the origin of his Schonstedter rye, which was introduced about 1867, and is now favourably known and extensively grown all over Germany. Both of these methods depend upon progressive or cumulative selection, the building up and adding together of small improvements. Breeders who are conducting careful experiments will find it necessary and desirable to use what may be termed statistical methods of judging their plants. While we are breeding possibly for one primary improvement, as, for instance, increased yield, it is at the same time necessary that we should keep the product up to the standard in other characteristics, namely, quality, disease-resistance, drouth-resistance, &c., and see that all of the good qualities of the variety are retained. To do

this properly necessitates the use of a score card, on which each character of the plant which is important is given its relative weight of importance. By the use of such a score card, the breeder can judge each character separate, and by the adding up of the scoring get the rank of different plants in a comparative way. The use of such score cards will be illustrated below.

TEST OF TRANSMITTING POWER.

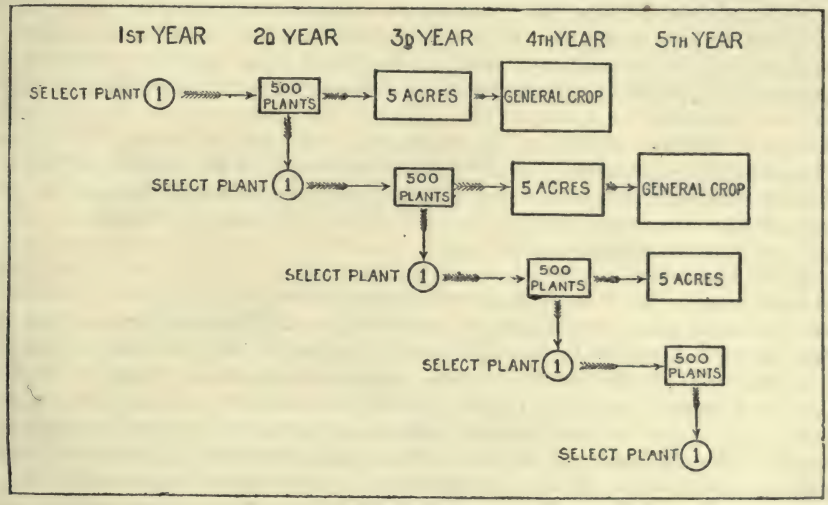
A factor of primary importance in all pedigree or grade breeding is the testing of what is termed the transmitting or centgener power. It is necessary for us to know that a certain plant which, for instance, gives a heavy yield, has the faculty of transmitting this tendency of producing heavy yield to its progeny. It is frequently found that two select plants which are equally good so far as their yield is concerned will give progeny which, as a whole, differ greatly in this respect. In the progeny of one, almost every plant may have inherited the quality, while in the progeny of the other only a few of the plants may show in any noticeable degree the inheritance of the quality. To determine this prepotency or transmitting power, it is necessary to carefully grade the progeny of each individual, and this is the primary reason for planting the progeny of different individuals in separate rows or separate plats, so that they may be easily examined. (Plate I.) It would seem to be an easy matter when we plant the progeny of different plants in rows or small plats by themselves to get the comparative yield, for instance, of 100 plants, and from this figure up the average per cent of the transmitting or centgener power. This matter, however, is very difficult in many cases. In corn, for instance, certain individuals may stool and form suckers that have fairly good sized ears. If the corn is planted thin enough on the ground, these suckers would tend to increase the yield, and render the proper judgment of the transmitting power very difficult. It would seem at first thought that such suckering if it increased the yield would be desirable, and should be considered a favourable character in connection with an individual. However, if the soil is heavy enough to have allowed this suckering to give increased yield, it would have been possible on the same soil to have placed the plants closer, and as seed is of little comparative value, it would be best to have a non-suckering type, and plant the corn as closely as the soil would properly permit. Again, it is almost impossible to get perfect stands, and a change in the stand may affect the yield. Very many difficulties and problems enter into the figuring out of this transmitting power, and it is obviously impossible to give directions for all cases. The breeder must study conditions and carefully determine what policy to pursue in each case.

AFFECT OF SOIL AND CLIMATIC CONDITIONS.

Many breeders are puzzled to know what character of soil to select for their breeding patches. Some claim that it is best to place the breeding patch on the best possible land where the plants will be induced to give their very highest returns. Others claim that it is better to locate the breeding patch on rather poor soil, which would tend to minimize the amount of variation. There is no doubt but that the growing of plants on very rich soil tends to make them apparently very variable. Whether this really affects their inherent tendency to vary the writer believes has not been satisfactorily determined. He, however, knows from experience that it is very difficult to secure what would be termed a uniform type of plant in the case of selecting hybrids, when the patch is grown on very rich soil. While no absolute directions can be given, it would seem to the writer that it is best in the majority of cases to grow the breeding patch on soil of the same character as that on which the ordinary crop is grown, so that when the improved variety or the pedigree stock has been produced it will be adapted to the conditions under which it is to be grown. The same may also be said so far as cultivation and manuring is concerned. It is probably better in most conditions to use the same methods of cultivation and manuring as are used in the production of the ordinary crop.

SPECIFIC ILLUSTRATIONS.

Methods of Cotton Selection.—The method of cotton selection and grade breeding which is followed by a number of careful breeders, and which the writer has utilized in his experiments, is illustrated in the accompanying diagram (Text fig. 1.) In start-



(FIG. 1.)

ing a selection in cotton, the breeder examines the plants grown in a general field of the variety used as the foundation stock. If the work is to be carefully done, a very large number of plants should be examined, and at least twice as many of the very best individuals marked temporarily as are desired for final planting. After this preliminary selection the marked plants should be more carefully examined with a clear ideal in mind as to the qualities desired, and the poorest marked plants should be thrown out until the selections are reduced to the required number of the very best plants which represent the grower's highest ideals. The method of pedigree or grade breeding can best be illustrated by basing this selection on the handling of a single individual, although in practice it is desirable and necessary that more than one individual be selected. Taking one individual, however, the breeder would plant the seed of this selected individual the second year, and this would produce about 500 plants. If upon examination of these 500 plants it is found that as a whole they show the same desirable characters as the parent, the selection would be considered to have been a good one, and further selections should be made from the progeny in the second year in order to continue the pedigreeing of the stock in the third generation. We will assume that the breeder selects simply one mother plant from among the 500, as illustrated in the diagram. The breeding stock seed of the remaining 500 plants should then be preserved to plant a larger multiplication field of about five acres the next year.

The third year the breeder would plant his breeding stock seed, and would also plant in an isolated patch the seed of the one specially selected plant of the second year. In the third year again he would select from among the 500 plants grown from a specially selected plant of the second year, another specially selected good plant to serve to continue the pedigree strain. He would also save the breeding stock seed from the remaining plants of the plat of 500 plants and the special stock seed from the plat of five acres, but would not keep the individuals separate. The fourth year the special stock seed developed directly from the individual plant selected in the first season would be sufficient to plant the general crop, and the seed developed from the individual specially selected in the second year would give him a small multiplication plat of about five acres. The seed developed from the single individual selected in the third

year would give him a small plat of about 500 plants, from which again in the fourth year he would select a specially good individual to continue the pedigree strain in the fifth year. It will be seen from following this method in connection with the diagram that it furnishes a means of continuous selection and the development of a pedigree strain. If the breeder each year keeps a record of the product of his different select plants, it is possible to trace the pedigree and performance record of each individual plant selected and its ancestors. If a specially selected individual at any point in the process does not hold up and show strong transmitting power, it and its progeny should be discarded. By utilizing this method of breeding, cotton has been greatly increased in yield and improved in quality. Sea Island cotton growers have thereby increased the average length of staple from about 1½ inches to nearly 2 inches on an average, and in specially bred strains up to the remarkable length of 2½ inches. (Plate 2.) In the writer's experiments he has been able to notice very marked changes in three or four generations of selection, and in the same way it is possible to increase the strength, fineness and other characters of the lint.

Tobacco Selection.—The work of the Department of Agriculture in tobacco breeding has shown the great importance of producing carefully select strains, and as considerable tobacco is grown in Canada, these experiments are of considerable interest here. In connection with the introduction of Sumatra tobacco growing in the Connecticut valley, it was found that the main difficulty in the successful growing of the crop apparently lay in the fact that under the new conditions the variety broke up and did not produce leaves of uniform shape. It was found, however, that certain individuals regularly produced leaves of the desired shape. Experiments conducted by Mr. A. D. Shamel, of the United States Department of Agriculture have shown that by carefully selecting individuals which produced uniform leaves of the type desired and preserving the seeds from these individuals in the proper way, it is possible to produce strains growing uniform leaves, where each plant, as a matter of fact, is so nearly alike that it is difficult to recognize features of differences. Tobacco, as stated above, is normally a self-fertilized plant, and one of the important features developed in connection with this work was the necessity of having the seed grown under bags in order to prevent cross-fertilization. For this purpose twelve-pound manila paper bags are used, and the plants which are desired for seed purposes should be selected just before the flowers begin to open. Some of the very small leaves at the upper portion of the stalk surrounding the flower cluster should be pulled off, and possibly also some of the flowers removed, after which a bag should be drawn over the flower cluster and firmly tied around the stem. By shoving this bag up on the stem every few days for about two weeks, during the period of rapid growth, the seeds will develop normally under the bag, and will be known to be self-fertilized, which in this case is desired. It has been found that seeds from such select plants grown under a bag give remarkable uniformity. Where plants are self-fertilized with their own pollen apparently no new hereditary tendencies are introduced, and the progeny seem to be almost if not quite as similar as in vegetative or clonal propagation. This great similarity of the progeny of self-fertilized plants occurs in plants which are normally cross-fertilized as well as in normally self-fertilized plants. It is a feature which breeders have made use of regularly in reducing hybrids to what we call a fixed state. In many cases, however, if not in the majority, the loss of vigour from such close inbreeding is such that it cannot be generally practiced.

The strains of Broadleaf and Havana which have been grown for years in the Connecticut valley have apparently run down considerably in productivity. By examining and counting the leaves on different plants there is found to be great variation, some plants producing nearly double the ordinary number. By selecting plants producing a large number of good leaves and saving the seed under bag to prevent any cross-fertilization, Mr. Shamel has found that many plants transmit in a remarkable degree this faculty to produce a large number of leaves. Similar increases have been obtained in the Maryland types of smoking tobacco and Florida Sumatra by Mr. Cobey, another agent of the department.

The process of suckering in the growing of tobacco plants is very tedious and costly, and growers have never had any suggestion of a method avoiding the necessity of suckering the plants. Mr. Shamel took the matter up from the standpoint of breeding, and found that certain individual plants of various varieties of tobacco, such as Sumatra and Cuban wrapper types, produce very few suckers normally, and has found that certain of these plants have strong transmitting power, and give progeny which are mainly suckerless. By similar methods it has been demonstrated that we can produce strains with better burning qualities, shorter internodes, finer veins, &c. Pratically any quality desired can be augmented by careful and continuous selection.

Pedigree Breeding in Corn.—The method of pedigree breeding in corn which is probably familiar to all plant breeders, is practically the same as that described above with cotton, and many modifications can be made by individual breeders. Probably there is no variety or race of ordinary corn cultivated that could not be greatly improved in yield or in other qualities of value by careful grade breeding. It has been shown conclusively that one can increase the depth of the kernel and the per cent of shelled corn per cob, can lower the average height of the ears, increase the length of ears, produce greater regularity in the rows of kernels on the ears, increase the starch, oil, or gluten content, &c.; indeed the possibilities in every crop are almost illimitable. In connection with the writer's experiments, one method that he has utilized in sweet corn breeding may be of interest. Here it is well known that there is considerable difference in the sweetness of the corn of different individuals. It is of course desirable that the sweetness and tenderness of the kernels be as great as possible, and we should select ear seed from those individuals which produce the sweetest and tenderest kernels. The writer has found that tests of the quality in sweet corn can be readily made by taking the individuals when they are in the proper stage for eating and pulling down the husks on an ear until the upper end of an ear is exposed. Then by the means of pruning scissors, or in some other way the upper portion of ear can be cut off and used in making either a chemical test of the quantity of sugar, or for cooking and testing by eating, an eating test being after all the final test. After cutting off the upper part of the ear, the husks can be drawn back and tied over the end, which will prevent the entrance of water or insects, and the base of the ear will develop in most cases normally. By recording the different individuals under distinct numbers, one is thus able to test the ears as to quality, and still retain a portion of the ear to be utilized as planting seed in case the individual is finally selected.

CAN WE PEDIGREE PLANTS?

Many other illustrations might be given, but a sufficient number have been cited to show the possibilities and interest of this field. The writer believes that no line of breeding work presents greater possibilities or greater value than what he has termed pedigree or grade breeding, and he trusts that some means may shortly be provided so that growers may register pedigree stock in a manner similar to the methods used by animal breeders. He believes that such a registration is feasible and practicable, and that it would greatly stimulate careful methods of selection, and be a protection furthermore to the growers interested in breeding. He believes that this registration should be by private organizations similar to the various organizations among animal breeders maintaining herd-books. Here the societies are made up of the individuals to be benefited, and they make their own governing rules. If a member is not benefited he need not register his new strain or race, but if the societies work is well done it will soon become important to register new things. Put a plan of registration in good working order and the writer believes that the now apparently insuperable difficulties would soon be overcome. Suppose that the American Breeders' Association should begin pedigree records of varieties of various plants, and for registration of a new race, strain, or clon require that an affidavit of pedigree and performance record be filed with a good description of the strain registered, photographs, &c., such records to be pub-

lished periodically from the fees charged for registration. Such records would, the writer believes, stimulate care and honesty. We now have too many varieties renamed to defraud the public into believing them new. A strong society by refusing registration to aggressors in this field has a strong whip to keep breeders, seedsmen and nurserymen in line and prevent dishonesty. Such a registration would tend to prevent the promiscuous renewing of sorts which is now a flagrant abuse of public confidence. If a man were to wilfully violate the rules of registration, he would soon be found out, and refused registration of his strains and new sorts. Such registration would soon result in the public buying only registered strains.

EVIDENCE OF IMPROVEMENT IN FARM CROPS BY SELECTION.

(By Prof. C. A. Zavitz, *Ontario Agricultural College, Guelph, Ont.*)

From the latest census report for the Dominion of Canada we learn that for the year 1901 no less than 19,725,016 acres of land were used for the production of field crops. The estimated value of the farm crops for the Dominion for that year amounted to $194,953,420. These figures show us the great value of the farm crops of our Dominion. It will be seen that even a slight increase in the yield and in the quality of these crops would mean a large increase in the total value of the productions of the country as a whole. It is well, therefore, for the Canadian Seed Growers' Association, the Agricultural Colleges, the Experimental Farms and all other available agencies to put forward their best endeavours to bring about improvements in our crop productions. In the paper here presented I shall confine my remarks almost entirely to experiences obtained and observations made in Ontario, and particularly in connection with the experimental work of the Ontario Agricultural College and of the Ontario Agricultural and Experimental Union.

SELECTION OF CROPS.

Great care should be exercised in the selection of those classes of farm crops which are likely to give the best results. The selection of crops is necessarily governed to a great extent by the location of the farm, the quality of the soil and the particular kind of farming which is being followed. As there are so many things to be considered in the selection of those crops which are likely to give the best general satisfaction, it is important that even this phase of the subject should receive much more attention than it is possible to give in this short paper.

In a study of the reports of the Bureau of Industries of Ontario, and of the results obtained through the medium of the Ontario Agricultural and Experimental Union, as well as by the results of tests made at the Ontario Agricultural College, we obtain some interesting information in connection with the relative production of some of our leading grain crops. In the following table we present the average yields in pounds of grain per acre of Barley, Oats, Pease and Spring Wheat, in four separate columns. The first two columns to the left give the results obtained through the Bureau of Industries for Ontario for the past twenty-three years and also for the past three years, and the two columns to the right give the results of experiments made for three years in connection with the Experimental Union and the Experimental Department of the Ontario Agricultural College:—

Varieties.	Ontario.	Ontario.	Expt. Union	O. A. C.
	23 years.	3 years.	3 years.	3 years.
Barley	1,301	1,584	1,856	2,714
Oats	1,217	1,319	1,758	2,634
Pease	1,170	1,128	1,604	
Spring wheat	942	1,082	1,183	1,716

It will be seen from the figures here presented that barley came first, oats second, pease third and spring wheat fourth, in every instance. It is interesting to note that the area devoted to the growing of barley in Ontario has increased very largely within the last five years; even more largely than that of any other farm crop grown in the province. This increase is due to several causes, among which might be mentioned the development of the live stock industry and the introduction of improved varieties of barley, more particularly the Mandscheuri, of which there is probably half a million acres now grown in Ontario annually.

SELECTION OF VARIETIES.

The writer is convinced that the proper selection of varieties of farm crops is of great importance. Each farmer should endeavour to find out which kinds of field crops are the most suitable for growing on the soil of his own particular farm. This information can be obtained by observing the results on neighbouring farms, by studying the reports of the experiment stations and by definite and systematic experimental work by the farmer himself. So thoroughly are the farmers of Ontario becoming convinced of the importance of studying these matters for themselves, that upwards of 4,000 are now carrying on co-operative experiments in connection with the Experimental Union. The results obtained through the experimental work of the Agricultural College and of the Experimental Union present many facts which show the importance of a proper selection of varieties, and of the great assistance which can be given to farmers through these channels.

As a few varieties of farm crops have now been under test at the Ontario Agricultural College for a period of fifteen years, it is interesting to note the comparative results of a few varieties. The records show that for the past fifteen years the average annual yield of grain per acre of the Mandscheuri barley was 11·7 bushels more than that of the Mensury barley; that the yield of the Siberian oats was 16·7 bushels per acre more than that of the Black Tartarian variety; and that the yield of the Wild Goose spring wheat was 9·1 bushels per acre more than that of the Colorado variety. As great differences exist between different varieties of grain crops in length of straw, strength of straw, susceptibility to rust and quality of grain, as well as in yield per acre, it seems unnecessary to say more regarding the importance of variety in crop production.

SELECTION OF PLANTS.

In the spring of 1903, 8,939 of the best seeds available of each of seven leading varieties of barley, oats and spring wheat were planted separately in our experimental grounds. Of this number, 2,739 were planted in squares one foot apart and 6,200 were planted in squares one link apart each way. As each seed was planted by itself and at an equal distance from the surrounding seeds, an excellent opportunity was afforded for studying the characteristics of the various plants of each variety. It is scarcely necessary to say that there was a great variation in the individual plants. For the sake of illustration, reference is here made to the Mandscheuri barley. Of this variety there was a variation all the way from *one head* to *twenty-eight heads* per plant. The average number of heads per plant of this variety was 11·8 where the plants were one foot apart. At harvest time a number of the very best plants were selected, with the object of starting new strains of this important barley. In the spring of 1904 the best seeds were taken from the selected plants and were sown in rows allowing one foot between the rows and also between the plants in the rows. On a careful examination of the crops comprising the different rows grown in 1904, it was found that the average number of heads per plant was 16·6, thus making an increase of 4·8 heads per plant, or of 40·7 per cent in one year. Somewhat similar results were obtained with the other varieties of crops under investigation. In the experimental plots at the college this year may be seen about 150 different strains of leading varieties of farm crops resulting from selected plants of six-rowed barley, two-rowed barley, hulless barley,

white oats, black oats, winter wheat, spring wheat, macaroni wheat, emmer, spelt, &c. We believe that we are working along the right lines, and that in the near future some very valuable strains of the best varieties of crops will be ready for distribution for experimental purposes and for growing on the farms throughout the province.

Some of the most interesting and valuable object lessons for the farmers who have visited the college this month, to the number of about thirty thousand, were the crops of oats, barley and spring wheat from selected seed. There are over six acres of grain growing at the present time as the result of six seeds which were sown just two years ago this spring. One acre of Mandscheuri barley, which is an object of great beauty owing to its vigour and evenness of crop, is the product from one seed which was planted in the spring of 1903. The seed here referred to, however, produced one of the largest plants obtained from among those produced from about 9,000 seeds planted at the same time and under similar conditions.

SELECTION OF SEED.

A large amount of experimental work has been conducted at the Agricultural College within the past fifteen years in the selection of seed of various kinds of farm crops. Some of the most important results obtained are here referred to very briefly.

Maturity of Seed.—Much has been said in regard to the proper time of harvesting crops in order to get seed which will give the very best returns. In the average results of fourteen tests conducted within the past seven years, we found that seed taken from winter wheat which was allowed to become very ripe before it was cut, produced a greater yield of both grain and straw and a heavier weight of grain per measured bushel than that produced from wheat which was cut at any one of four earlier stages of maturity. The results of this experiment seem to show us that with winter wheat, at least, it is wise to select seed which has become thoroughly ripened before it was harvested.

Plumpness of Seed.—In order to ascertain the comparative values of plump and shrunken seeds, a large number of tests have been made at the college within the past eight years. Fresh seed has been taken each year from the general crop of grain grown in the large fields. It will therefore be understood that whatever difference there is from the influence of the selection of seed, that difference is attributed entirely to the careful selection of seed for the separate years in which the tests were made. For the large plump seed none but well developed seeds were selected, and for the shrunken seed none but shrunken grains were used, the last selection being made regardless of the size of the kernels. From the selection of large plump seed exactly one-half pound was taken for each class of grain, and the number of seeds was then carefully counted. Exactly the same number of seeds were then taken from the selection of shrunken grain. At the proper time the two lots of each variety were sown on plots of uniform size. The averages of several years' results show that in weight of grain per measured bushel and in yield of both straw and grain per acre, the large plump seed surpassed the shrunken seed in every instance, for each of the grains, barley, spring wheat and winter wheat. In averaging all the results, it was found that the plump seed gave a yield of 20·2 per cent more than the shrunken seed.

Size of Seed.—We have conducted experiments for at least six years in succession in comparing large plump and small plump seed of each of five classes of grain crops. In all the tests equal numbers of seeds of the two selections were used. The following gives the average yield of grain per acre for the several years during which each experiment was conducted:—

Oats—Large seed, 62 bushels; small seed, 46·6 bushels.

Barley—Large plump seed, 53·8 bushels; small plump seed, 50·4 bushels.

Winter wheat—Large plump seed, 46·9 bushels; small plump seed, 40·4 bushels.

Spring wheat—Large plump seed, 21·7 bushels; small plump seed, 18 bushels.
Pease—Large seed, 28·1 bushels; small seed, 23 bushels.

In averaging all the tests made with the five kinds of grain, it is found that the large plump seed gave a yield of 19·1 per cent more than the small plump seed, as the direct result of the first selection.

For twelve years in succession an experiment has been conducted at the college in breeding oats by means of the selection of the seed. The variety of oats used was Joannette Black. In the spring of 1893 several thousand large black oats were selected, and an equal number of oats which were lighter in weight and lighter in colour were also selected, and these oats were sown on plots uniform in quality and in size. The selections made in each of the following years have been from the product of the selected seed of the previous year. In 1904, which was the twelfth year of this experiment, the large plump seed gave a yield of 26·1 bushels per acre, and produced grain which weighed 10·5 pounds per measured bushel more than that produced from the light seed. It is also interesting to note that the crop produced from the large plump seed required only 1,390 grains to weigh one ounce, while the crop produced from the light seed required 2,095 grains to make the same weight.

Soundness of seed.—According to the results of experiments conducted in each of twelve years, it has been ascertained that oats from which the hulls had been removed in the process of threshing and which are still fresh will germinate almost perfectly, and will give nearly as good results as seed from which the hulls had not been removed.

Unless care is exercised, a considerable amount of grain is frequently broken in the process of threshing. In order to ascertain the amount of injury done to the germination of the grain by means of its being broken at the time of threshing, experiments have been conducted for at least six years, by sowing both sound seed and broken seed of barley, winter wheat and pease, and the results carefully recorded. The following gives the average yields of grains per acre of each selection of each class of crop:—

Barley.	Sound seed, 53·8 bushels.	Broken seed, 46·0 bushels.
Winter wheat.	Sound seed, 46·9 bushels.	Broken seed, 9·3 bushels.
Pease.	Sound seed, 29·2 bushels.	Broken seed, 10·2 bushels.

As the barley nearly always breaks crosswise of the grain, the germ is usually left uninjured. In the case of winter wheat and pease, however, the grain usually breaks along the crease and in very many cases the germ is either totally or partially destroyed.

As we sometimes have wet weather at the time of harvesting our crops, a considerable amount of the grain becomes more or less sprouted before it can be properly cured. As the winter wheat crop was badly sprouted in 1897 and again in 1902, it gave us an opportunity in each of these years to compare the value of sprouted and unsprouted seed. As the results of tests made in those two years we found that the wheat which was in the field during the rainy weather, and which showed no signs of being sprouted, gave a germination of 94 per cent, while that which was slightly sprouted gave 76 per cent, that which was considerably sprouted 30 per cent, and that which was very badly sprouted only 18 per cent of germination.

BARLEY AND OATS GROWN ON THE SAME FARM FOR 15 YEARS WITHOUT CHANGE OF SEED.

Eight varieties of barley and eight varieties of oats have been grown on the College Farm for 15 years without change of seed. Care has been exercised each year to select the best grain for seed purposes. It is interesting to note that in every one of the sixteen varieties grown for fifteen years, the average yield per acre for the last five years has been considerably greater than that for the first five years of this period. The following table presents the average yield of grain per acre for the first five and the last

five years of the period here referred to for each of four varieties of barley, and of four varieties of oats.

Varieties.	Average Five Years. 1890-4.	Average Five Years. 1900-4.
	Bushels.	Bushels.
Barley—		
Mandscheuri	65·2	73·5
Mensury	52·1	63·1
French Chevalier	56·9	64·2
Black Hulless	39·8	51·5
Oats—		
Siberian	73·3	102·6
Egyptian	70·7	86·1
Joanette Black	83·2	98·2
Black Tartarian	61·9	84·6

These figures here presented show us that it is quite possible to grow the same varieties of grain on the same farm over a considerable number of years without change of seed, providing great care is exercised each year in the selection of the seed, and in the handling of the crop.

CONCLUSION.

From the evidences of the improvements in farm crops by selection, as presented in this paper, it seems clear that the work of the Canadian Seed Growers' Association should produce valuable results, providing the work is conducted along the right lines, and with great care throughout. By a farmer first selecting the most suitable classes of farm crops and the best varieties of each class for his own particular circumstances, and then by making a constant and persistent selection of the best heads and of the best seeds of such variety, a marked improvement, both in the quantity and the quality of the crop produced should result therefrom.

Mr. DONALD INNES.—Before I entered this competition I always graded my seed with a Chatham fanning mill, and sowed the large plump seed. Some farmers advocate a frequent change of seed, but I found it quite unnecessary. In ten or twelve years of this process with the Banner oats, I have kept up their quality and increased the yield.

The variety of wheat chosen was the White Fife. The first year we sowed an acre plot, but the succeeding years that was reduced to one-quarter acre.

I found that in going through the plots to select the heads, we tramped down the grain. But the second year, we adopted Prof. Robertson's suggestion to block up one of the spouts of the drill and thus allow a path to walk in.

We used land that has been in potatoes the preceding year. The amount of seed used to sow the quarter acre was 28 pounds. In selecting heads we took enough for about 50 or 60 pounds of hand-selected seed for next year's plot, besides the 100 heads to send to Ottawa. When the grain was growing we would go through the plot occasionally to weed out any weeds we could find. After the heads we had picked were thoroughly dried, we put them in a common grain bag and threshed them in it. In that way we did not lose any of the grain.

Mr. Chairman, some will say they could not spare the time to hand-pick so many heads, but I tell you it is time well spent. The first year we had a return from the quarter acre plot of 480 pounds of Improved seed. The yield increased each year, and in the main competition, we had a yield of 605 pounds of Improved seed. That gain of 125 pounds in the yield of a quarter acre in three years should show every farmer the benefit of seed selection. I do not say that all the increase came from the good seed, but at least two-thirds of it is due to that cause.

We chose the Early Blossom oats for the competition on account of its large head, and were justified in doing so, for out of the three years that we sent heads to Ottawa, we got first prize twice and third once, and first again in the main competition. The first year the yield was 714 pounds, and the last year 852 pounds, giving an increase of 138 pounds in the three years.

Although as yet I have not made many sales of registered seed, I have been amply repaid for my work by the increased yield I have been getting. Since the seed fair held last winter in the maritime provinces the demand for Improved seed has been greater.

Mr. F. KIRKHAM.—My farm is situated about five miles from the village of Saltcoats, E. Assiniboia. The character of the land is rolling, and more suited to a system of mixed farming than to wholesale grain growing.

The variety of wheat which we chose for the Macdonald-Robertson competition is the White Fife. We chose it on account of its being an earlier ripener than the Red and of as good milling qualities. In the oat competition we chose the Danish White on account of its large yield, resistance to rust and strength of straw.

We followed closely the instructions given by Prof. Robertson. For our seed plots we use new land broken the previous June or land fallowed the previous summer. We much prefer the new land, as wheat on it is from one to two weeks earlier in ripening than when it follows grain or fallow; and an early harvest gives a bigger kernel and a more uniform sample. We gave no special preparation for the seed plots beyond the usual working for ordinary operations. Every third spout of the drill is blocked to give room to make the selection without trampling the crop. Plenty of room tends to the production of larger and better heads. It is highly probable that the blocking of alternate spouts would give even better results as to larger heads. In selecting heads, it is better to take plenty of time to be sure of having made the best possible selection.

For sixteen years we have grown White Fife continuously, and before we adopted this method of selection, the heads had become so small as to attract the attention of observant people. Now the opposite is the common comment. After the sowing of two years' selection we got rid of the original stock. The last three years we sow nothing but the product of the second sowing from the special seed plot. As a consequence, there is none of the old stock growing to enable us to judge what the entire improvement has been since 1900. I am well satisfied the difference would not only be a visible but a palpable one.

The demand for seed grain is increasing as it becomes known. When the full value of our selected grain is known, how it is true to variety and free from noxious weeds, I imagine it will be beyond our ability to supply the demand. But seedsmen and farmers will do well to remember that it is not reasonable to expect to be able to purchase hand-selected seed at the same price as run-out grain mixed with half a dozen other varieties and noxious weeds.

Mr. THOS. THOMSON.—After examining the different fields of wheat on the farm carefully, we came to the conclusion that the best heads grew on one of the highest fields. Here the crop of straw was lighter, and the heads, although not nearly as long as we had found on the new land, had six rows of grain instead of four, and had plumper, heavier berries.

From our acre plot of the first year we picked enough heads to make twenty pounds of clean grain besides the hundred heads for the competition. As soon as it was dry enough we threshed it by hand, as there was little chance of keeping such a small quantity pure if put through a large threshing mill. The greatest trouble we have to contend with in keeping our seed pure is in threshing, as it is almost impossible to get a thresher to clean out his machine thoroughly.

We made our plot oblong in shape for three reasons: First.—In picking the heads we found most of the large ones around the outside of the field. Second.—We could walk up either side and see any weeds that should be pulled. Third.—We could select the heads without trampling the plot.

Before putting it in the drill we treat our seed wheat with bluestone to prevent smut. One-half pound to one gallon of water is the proportion we use. As soon as it is dry we sow, setting the drill at one and a quarter bushels per acre. If the machine is working properly the twenty pounds of seed will be about right for the quarter-acre plot.

The first year we left a strip between the plot and the main crop unseeded, so that we could get around with the binder. But as we had to cultivate this to keep down the weeds, we came to the conclusion that we might as well have grown a crop of potatoes on it, and did so the second year.

The second year we tried the experiment of stopping every third spout in the drill, with the view of increasing the number of large heads, but as this gave the weeds too great a chance in the early part of the season, we discontinued it. As the land, on which these plots have been, was either new or had been very little cropped, we never applied any manure.

Although we have not sold any selected seed till this year, I am perfectly convinced that it has been a paying experiment from the very first. Our yields have been increasing for the last four years, and I think that the selected seed ought to be credited with the greater part of the improvement. Our average yield on quarter-acre plots has been about eight bushels, and the yield on the plot sown with the product of the quarter-acre has reached as high as 250 bushels. So, it takes a very short time till enough pure seed can be raised by one man to seed a whole farm. I have no doubt that in a short time there will be a great demand for good clean seed, and that it will be a profitable business to all those who have spent their time and taken the trouble to keep their seed pure and clean.

Mr. W. L. Dixon.—I began to improve the Golden Giant variety of oats in 1900 in connection with the Macdonald-Robertson seed grain competition. I had grown this variety two years before this, having eight pounds seed from the director of the Ottawa Experimental Farm. I began with the Banner variety in 1901.

The first year of the competition we sowed one acre; the succeeding years, only one-quarter acre. I think it was a mistake to reduce the plot below one-half acre, as a half acre will produce enough grain to sow all the oat fields on a hundred-acre farm, and thus prevent the grain becoming mixed. Another advantage in having a larger seed plot is that the selection of the best heads will not reduce the average of the quality of the improved seed grown on the hand-selected seed plot, as must be the case when too many hand-selected heads are taken from the smaller plot. I would suggest that where a half acre plot is kept that the hand-selected heads be taken from only part of the plot, and that the remaining part of the plot be classed as improved registered seed. The grain on the hand-selected seed plot is sown at the rate of about 20 pounds per quarter acre, the drill sowing with only each alternate spout. Last year we produced over 30 bushels Golden Giant from 16 pounds of seed sown in this way. The grain should follow corn or potatoes to ensure rich, clean soil. A coat of nitrate of soda sown when the grain is about 2 inches high, and another coat when it is 6 inches high is beneficial. Last year we did not use any fertilizer. It followed pease.

I know that the general crop of the farm in oats is at least 10 bushels per acre better than it was several years ago; but how much of this is due to seed selection I am not prepared to say; but I think that much of the improvement is from this source.

The field on which I sowed my improved registered seed last year returned a better crop than the other oat fields on the farm. I could have sold it all for about ten cents per bushel above the market price. I sold some higher, but I did not think it would pay to do the extra teaming and cleaning for this difference of ten cents, when I would have to buy oats for feed.

The time required to select the heads for the first plot of one acre was about six days. Thirty pounds of heads, carefully selected, is about a day's work for one. These may not weigh more than 20 pounds when dried, threshed and screened.

I would advise new members to keep the heads dry, and where mice cannot reach them; to sow oats early in the spring, but not so early as to get the grain stunted or

rotted in the ground by the snows, cold rains, and frosts of such a spring as the one we have just had. Thresh the hand-selected heads with a flail, to ensure their being kept clean. Pick the seed grain as well as screen it, for the hand-selected plot.

Mr. C. R. GIES.—For the last five years I paid special attention to the selecting of seed wheat, and I find that my extra labour has been well rewarded by the increase in yield of the crops and the quality of the grain.

A great many people attach a great deal of importance to frequent changing of seed. Now, while I believe an occasional change of seed is good, I cannot attach the importance to it that many do. I have not changed seed with any farmer since 1891, and in the Macdonald Seed Grain Competition, which was open to the province, my seed carried off the first prize in the main competition. From that you may judge the quality of the grain. In my opinion the successful raising of grain depends largely upon the proper and careful selection of seed.

WHAT CAN THE FARMER DO TO IMPROVE THE YIELD AND THE QUALITY OF GRAIN?

(By HARRY SNYDER, B.S., *College of Agriculture, Minnesota.*)

The various factors which influence the yield and quality of crops are: Seed, soil, climatic conditions, time of harvest, care of the crop, fungus diseases and insect pests. With the exception of climatic conditions, all of these factors are largely under the control of the cultivator, and by exercising the necessary care in the selection of seed, and in the cultivation of the soil so as to improve its physical condition and increase the store of available plant food, it is possible to materially increase the yield of cereals, and also to improve their quality.

The fact that you have formed a Seed Growers' Association shows that you are well informed as to the importance of good seed. The reasons why selected seed has the advantages over common seed are not difficult to discover. In the selected seed a special characteristic, as early maturity, glutinous character, large yield, or evenness as to time of ripening, is intensified. These are largely inherited physiological characteristics. In the case of starchy and glutinous characteristics, these are associated with differences in chemical and physical composition. There is greater individuality among seeds than is generally conceded. In a bushel of wheat, for example, the kernels have certain characteristics in common, and also each kernel has its individuality. In nearly every sample of wheat, two types of kernels can be distinguished, one of which is more glutinous than the other. An investigation conducted at the Minnesota Experiment Station during the past year has shown that, in over a hundred samples of wheat grown in different localities, it was possible in each individual sample to readily distinguish two types of wheat; glutinous and starchy. Some of the wheats had been grown from uniform lots of seed, originally developed from single mother plants, and even in these cases the two types of wheat were as pronounced as in any commercial sample. In one instance the starchy kernels from such wheat contained 11·98 per cent of protein, while the glutinous kernels contained 16:85 per cent. I cite this case simply to illustrate the individuality of wheat kernels. Separate wheats grown from a uniform lot of seed have shown a range in protein content of from 13·81 to 17·51 per cent, and individual seeds from the same head have shown a difference of 1·62 per cent. This suggests that in all varieties of wheat there are two fixed types, the glutinous and the starchy. In some cases the differences are so slight as to scarcely affect the physical properties or the general appearance of the grain, but nevertheless they are present, and in the course of a few years become more pronounced.

In the selection of seed wheat, what shall be the type to which preference shall be given? The North-west (and I use the term without reference to boundary lines) has

become known largely through the excellent quality of its hard spring wheat. This then, it would seem, is the logical standard to adopt; and in the selection of wheat for seed purposes it should be the aim to develop the best yielding strains of hard glutinous wheat.

Some misconception exists as to the relative importance of protein or gluten in assigning a value to wheat. It is generally held that the larger the amount of gluten the more valuable the wheat for flour and bread-making purposes. This is true only to a limited extent, as an excess of gluten, over 15 per cent, does not add to the bread-making qualities of the flour. Hence it is not necessary to aim to develop wheats of abnormally high gluten content. To do this, it would be necessary to sacrifice yield, as abnormally high gluten content and a very large yield are antagonistic. The sound, high yielding, and medium-gluten-content wheat is undoubtedly what will prove the most valuable for the farmer, the miller and the baker; it is certainly a safe type of wheat to adopt as a standard. A great many of our wheats contain too small an amount of gluten, and in the selection of seed due regard must be given to maintaining the glutinous character of the grain; but this should be combined with other desirable characteristics, as high gluten alone is not the only desideratum.

This Association has developed some excellent plans for the improvement of cereal crops, and in the improvement of varieties it is to be hoped each grower will formulate definite standards, to which he will endeavour to have his crops conform.

Seed selection and pure seed alone will not solve the problem of better grain production, unless due regard be given to the cultivation of the soil and the conservation of its fertility. Large yields of grain cannot be secured from poor soils. Most soils in the North-west are in a high state of fertility, but exclusive grain raising, without rotation of crops or any other method being employed to conserve fertility, will ultimately result in lower yields and poorer grades of grain. There is a vital relationship between seed and soil. The improved varieties of grain demand larger amounts of plant food in order to produce larger yields, and, unless the soil responds, all the results from improved seed are lost. Seed and soil stand in the same relation in crop production as breeding and feeding in live stock production; neither alone can produce as good results as when both are jointly employed.

The way in which wheat is sometimes grown, continuously upon the same land, with little or no cultivation of the soil, burning of the stubble and straw and the use for seed of the left-over or unmarketable grain containing foul weed seeds and foreign grains, has resulted in reducing the yield. When wheat is grown as one of the main crops in a rotation, and some live stock is kept and manure is judiciously used, it is not an exhausting crop; it is only when it is grown exclusively that it results in impoverishment of the soil.

In the cultivation of the soil in the more northern latitudes there are many unsolved problems, particularly along the lines of crop rotations and the most suitable methods of cultivation. There is much need of some legume that will prove adaptable to a rotation for northern climatic conditions. The preparation and use of farm manures must also be modified to meet new conditions. Many of these problems relating to soils and crops for the more northern agricultural regions are being successfully solved.

The promotion of good seed grain through Seed Growers' Associations is one of the best means for improving the agricultural condition of a country. In this work, seed and soil must be jointly considered. The farmer, by judicious use of selected seed, more thorough cultivation of the soil, rotation of crops and the use of farm manures, can materially improve the yield and quality of his crops, secure a larger income for his labours and conserve and utilize to better advantage the soil wealth of his farm.

Seeds of Cotton showing variation in amount of fuzz on seeds from different bolls of the same hybrid plant. (Natural size).

THE SCIENCE OF PLANT BREEDING.

(By HERBERT J. WEBBER, *Physiologist in charge of Laboratory of Plant Breeding, U.S. Department of Agriculture, Washington, D.C.*)

HISTORY.

We are inclined to think that plant breeding is based on old and well established laws. The fact is, however, that the fundamental principles of plant breeding were not made known until the latter part of the eighteenth century. The sexuality of plants was established experimentally by Camerarius, in 1691, and the first hybrid of which we have any record was made by Thomas Fairchild, an English gardener, in 1719, being a cross of the Carnation with the Sweet William. Hybrids were quite carefully studied by Koelreuter, but not from a practical breeding standpoint. So far as our knowledge goes, plant breeding had its real beginning with the work of Thomas Andrew Knight, an eminent English plant physiologist, working in the early days of the nineteenth century. About the same time Van Mons, a Belgian horticulturist, also carried out experiments in a similar direction, and a large share of our knowledge of plant breeding has come down to us from these two investigators. Knight worked mainly in hybridization, and in 1806 said: 'New varieties of every species of fruit will generally be better obtained by introducing the farina of one variety of pollen into the blossoms of another than by propagating from a single kind.' Knight also enunciated what we may call the law of food supply, which is now quite generally recognized. This predicates that one of the principal factors which causes or induces variation in plants is an increase of food supply or a modification thereof. Van Mons worked mainly in selection, and it is interesting to note that his experiments were carried out primarily with pears. He preached the doctrine of continuous selection, and produced very many valuable varieties. Van Mons and Knight, therefore, were the exponents of the important factors of selection and hybridization in plant improvement. It is probable that a large portion of the success of Van Mons' work was due to the fact that pears are normally sterile to their own pollen, requiring cross-fertilization, and, therefore, many of his new varieties were probably hybrids. He was not, however, aware of this fact, and it made no great difference in the establishment of the principle which has since proven to be so important.

In this country very valuable work was done in the improvement of plants, and in discovering the principles of plant breeding, by Carman, Pringle, Hovey, Ricketts, Rogers, and others, and in more recent years by Bailey, Burbank, Hays, and very many others.

The rediscovery of Mendel's now famous law by DeVries and Correns, in 1900, and the publication of DeVries' Mutation Theory in the same year, marked the beginning of a new era in plant breeding. No matter what the final conclusions may be regarding Mendel's principals and the Mutation Theory, the general attention and investigation directed to plant breeding as the result of these two theories will serve to greatly modify and extend our understanding of the general laws of breeding. In the present paper the writer does not propose to go very deeply into the scientific factors governing plant breeding, but hopes simply to emphasize those matters of importance which should be understood by practical breeders.

FACTORS OF BREEDING.

Heredity.—The laws of heredity are of primary importance to the breeder. It is a general principle that ordinarily like begets like, but it is also true that like frequently gives rise to unlike. There are thus apparently two conflicting principles in plant breed-

ing. On the one hand, the breeder seeks to produce variations in order to get new types as the foundations for improvement. On the other hand, when such a variation from, or improvement on, the normal type, is secured, he then reverses the process and tries to establish the law of heredity and reduce the amount of variation so that the aphorism, 'Like begets like,' will hold true.

In pedigree or grade breeding, and in breeding to produce new varieties, the importance of hereditary strength, prepotency, or transmitting power, cannot be overestimated, as it is only by rendering this power very great that any new type can be brought to what we would call a fixed type.

Unity of Individual.—The unity of the individual is also an important factor in plant breeding. If, for instance, one is attempting to produce a seedless fruit, it is important that he discover the tendency to seedlessness in the entire individual. It would not be the correct policy for a breeder to select simply a single fruit which might accidentally be nearly seedless. He should examine a large number of fruits of different individual plants, and find a plant on which he can discover a general tendency toward seedlessness, showing in all of the fruits produced. By selecting seed from such individuals he may be able to find in time one such individual that would transmit to its progeny this tendency to produce few seeds. While this is certainly generally true, there are some instances in which further divisions of the individual are important. As an illustration may be mentioned the case of hybrids between a smooth and fuzzy seeded cotton, where one is breeding to produce a smooth, black seed, it may be found desirable to select a portion of an individual. In this case the writer has found that very frequently a cotton hybrid of the above parentage will produce bolls that vary greatly in the amount of fuzziness on the seed, and this variation does not seem to be limited to any part of the plant in particular, but seems to be a variation in certain branches or bolls, and is thus a sort of bud variation. In such hybrids one boll may be found to have seeds nearly smooth and black, and it is interesting to note that the seeds in each boll are very uniform in this character, while another boll may produce seeds which all have considerable fuzz. Plate I. The writer's experiments have shown that by taking seed from certain bolls in which the seeds are nearly smooth and black, a much larger number of plants are produced the next year with smooth black seeds than are produced when bolls are selected in which the seed have considerable fuzz, although the seed in both cases were borne on the same plant. This illustration shows that in some instances it is desirable to select a certain fraction or part of an individual which shows more clearly the character desired. Another illustration of the same kind is found in the case of colour in corn kernels. Where one is dealing with hybrids of corn of different colour it is well known that the kernels on the same ear may vary in colour, and if the investigator is attempting to produce a certain colour he should select to plant only those kernels that have the colour which it is desired to produce in the new strain.

Variations.—It is well known that all plants vary. Plants differ from each other just as do different men. Each plant has a facial expression, as it were, which marks it as distinct from any other plant of the same variety. These slight fortuitous or individual variations are of the greatest value to the plant breeder. These are the variations which, as explained in the writer's paper presented this morning, are of the greatest value in connection with what may be termed pedigree or grade breeding. By these variations alone, however, we would not expect to produc strikingly new varieties. The other forms of variation which are of most value to the plant breeder are the so-called 'sports,' or mutations, which are also known as saltatory variations. These differ from individual variations only in degree. They are what may be termed large-type variations. A very large number of our new races and varieties of cultivated plants are the results of such mutations or seedling sports. All vegetable growers know that far the larger number of their new varieties are apparently produced suddenly. For instance, Livingston, who has bred a great many new varieties of the tomato, followed the practice of carefully examining his different plants for variations. Occasionally some striking,

new type differing from other varieties, would be found. This was selected and used as the foundation stock of his new varieties. Our good apples, pears, peaches, &c., have been found in many cases in fence corners, and our new varieties of wheat, cotton, and other crops, are very largely strikingly good plants which, because of their superior quality, have attracted the attention of growers, and have been propagated. While many of these accidental discoveries are doubtless of hybrid origin, still it is probable that the majority are simply mutations or sports.

The third type of variation which is of importance to the plant breeder is that produced by hybridization or crossing, and here we probably have the most prolific source of variations, and, therefore, the class of variation of the greatest importance and most consequence to the breeder. It has come to be an established policy to combine the good qualities of two races into a single race by hybridization and selection.

Influence of Environment.—It is a well known fact that environment has a decided influence on the form and character of the plant. It is by no means certain, however, that these changes are of any value to the plant breeder. It seems certain that those changes which are the consequence of environment purely are not hereditary, and it is thus doubtful whether any such changes are of utility in plant breeding. It is a well known fact that if climbing or twining beans or viny cowpeas are transferred from a southern to a northern section or from a lower to a higher altitude, they tend to produce a more dwarfed type, which will not show the twining or viny habit in such marked degree, and breeders have sometimes advocated, in order to secure bush types by selection, the transferring of types to more northern latitudes or to higher altitudes, where the experiments may be carried on under conditions that naturally lead to the production of a lower bush type. It is doubtful, however, whether such a transfer would be of material aid. While it is recognized that such variations are produced as an influence of the environment, it is also known that on the whole those variations which are produced as an immediate influence of the environment are not hereditary. Individual variations are of greatest use to the plant breeder. Without question if the cowpea or bean were cultivated under southern conditions they would show individual variations in the degree in which they show the climbing or twining habit. Even under southern conditions certain individuals would doubtless show more of the bush type than others. It is believed by the writer that a bush type could be secured just as quickly under southern conditions by selecting from these lower and more bushy types as it could be obtained by the same selection carried on in more northern localities or at higher altitudes. Many plants exhibit this direct influence of environment, and such variations were termed by Darwin, 'direct variations.' A well-known illustration of such variation is the 'knees' produced on the roots of the bald cypress. For centuries the cypress has grown normally in marshes and swamps, and under these conditions seems to have developed a tendency to produce the knees which, so far as modern research goes, are of service to the plant in securing aeration. It would seem that this character which has been produced so long would have become hereditary. Nevertheless it has been found that when the cypress is transferred from the swamps and grown on fairly high ground where the soil is thoroughly aerated no indication of the knee formation is discovered. They are thus formed directly as an influence of the environment, and are not hereditary. A similar illustration is furnished by the southern nettle (Cnidosculus). In the interior of Florida this plant forms divided or cut leaves. When the plant is found growing on the sea shore, however, under saline conditions, it is observed that the leaves become much more entire, and the stems have a tendency to thicken up and become fleshy and cactus-like. These variations which are produced as a direct influence of the environment are not hereditary. It is important to consider in this connection the conditions under which the breeding patch should be cultivated. As stated in my paper this morning, some growers are inclined to locate their breeding patches in the garden, and give the plants the very best possible care, thinking that this is the best means of determining which plants are superior. Animal breeders also isolate their breeding stock, and give them

every possible care and advantage. Some plant breeders, on the contrary, claim that it is best to have the breeding patch located on those soils which are most nearly the same as those on which the general crop is to be cultivated. The writer has given this matter considerable thought, and he is strongly of the opinion that the most satisfactory method is to cultivate the breeding patch under the same conditions under which the ordinary crop is to be grown. Plants are fixed in one place, and are entirely dependent on the local soil conditions. If, therefore, the plant has been bred and adapted to one soil condition it cannot be expected to give as good results under different soil conditions. If a variety is being bred for sterile soils the selection should be conducted on similarly sterile soil in order to breed a race of individuals which are 'gross feeders,' as planters term it, and capable of deriving their nutriment from sterile soils and making a sturdy growth even under adverse conditions. If, for example, plants were being bred to adapt them to alkaline conditions the breeding patch would not be placed in a sheltered, favoured spot, where the soil did not contain alkali. The plants should be grown under alkaline conditions in order to discover—as a result of natural selection—those plants which would do the best where the alkali was present, and thus guide us in the selection. The same would be true in breeding plants for arid regions. The plants should be cultivated in the arid district rather than in a moist region of heavy rainfall, or in a thoroughly irrigated patch. In the same way the writer believes if plants are being bred for a sterile soil it is well to have the breeding patch cultivated on that kind of soil, so that the breeder may find the plants which thrive best under such conditions. Fine breeds of stock are less subject to adverse conditions in environment than are plants. The grower is able to give his stock almost uniform conditions no matter in what part of the country his farm is located. He brings food from distant parts of the country, and builds sheds to protect them from the cold. If, however, a breeder found it necessary to breed a hardy race of cattle that would be able to maintain themselves without protection in the winter, he would be obliged to keep them under the some conditions as those for which they were to be bred. This would be necessary in order to discover the individuals which were hardiest and best fitted to stand the severe winters to which they would be subjected.

In urging that the breeding patch be placed on the ordinary soils and cultivated under the conditions to which the crop is to be subjected, it is not intended to convey the idea that the breeding patch should not be given careful cultivation. Slipshod methods of cultivation should never receive encouragement. The breeding patch should be placed on the same soil as that where the crop is to be planted, and given thoroughly good cultivation, and such thoroughly good cultivation should also be used in the field when the crop is cultivated on a more extended scale.

PRINCIPLES OF SELECTION.

In my paper presented this morning, on the methods of pedigree or grade breeding, I described the methods of selection as applied to improvement within the race. Selection, however, is the principal factor of breeding, both in the improvement of races and in the production of new races or varieties. The key-note of selection is the choice of the best, and a factor of the highest importance is the examination of very large numbers in order to secure the maximum. Galton, in a scientific paper on this subject, says: 'One generation of 99-degree selection is seen to be more effective than two generations of the 90-degree selection, and to have about equal effect with the 80-degree selection carried on to perpetuity. Two generations of the 99-degree selection are more effective than four of the 95-degree, and than the perpetuity of the 90-degree.' The use of degrees in representing the perfection in which a character is shown may not be possible, but it is possible for any breeder to examine large numbers and find one or two plants which produce the character desired in the greatest degree. And it is these plants that should be preserved as mother plants in starting the selection.

In the production of new races it is of interest to us to know whether by pure selection we can lead plants to vary so greatly that they may be considered to have

passed beyond the bounds of the race, and thereby the breeder to have established a new and distinct race. It is certain, of course, that by careful observation and selection from any particular race ultimately a new race may be produced. The question here is whether the individual or individuals selected in producing the new race have not varied by mutation or seed sporting rather than simply representing the cumulative result of the selection of slight individual variations. The sugar beet furnishes an interesting illustration in this direction. It will be remembered that Louis Vilmorin started the selection of sugar beets for richness in sugar, between 1830 and 1840, selecting first by means of specific gravity, the method being to throw the beets into solutions of brine strong enough so that the great majority of them would float, the few which sank being of greater specific gravity and presumably of greater sugar content. Considerable improvement was produced by this method, but about 1851 the method of chemical analysis was introduced to determine the exact sugar content. At this time the sugar content was found to vary from 7 to 14 per cent, and in the second generation of selection individuals with 21 per cent of sugar were found. The selection based on sugar content, using the beets highest in sugar content as mothers, has been continued regularly ever since this time, and the industry has come to rely entirely on careful selection for high sugar content. It would be expected that under these conditions the sugar content would have increased sufficiently so that the selected plants could be considered a different race or strain. Yet, after fifty years of selection, the highest sugar content found is only about 26 per cent, and this in a very few instances, seldom over 21 per cent being found. At the present time many thousand analyses are made every year so that abundant opportunity is afforded to find individuals producing a high sugar content. On the contrary, when Vilmorin's work was started the determination of sugar content was by very laborious methods, and was limited to comparatively few individuals. It is not improbable that if Vilmorin had been able to make analyses of the sugar content in many thousands of roots he would have found certain individuals producing as high as 26 per cent. The inference from this illustration would be that the limitations of the variation within the race have not been surpassed as a result of selection. It may be argued, however, that in this case we are dealing with a physical impossibility, as it is clearly evident that it would be impossible for a plant to produce a root containing a proportion of sugar beyond a certain per cent, and it is thus possible that 26 per cent or thereabouts represents the maximum.

It must be admitted that in many cases we have an apparently cumulative effect of selection, and it seems almost impossible to draw the line between improvements created by continuous selection of slight individual variations within the race or the selection of those plants which are mutations. In the case of the gooseberry, tomato, and many other plants, the fruits have been gradually increased in size until they are now from four to eight times that of the original wild fruits. Much of this increase in size has of course been accompanied by hybridization between different wild species and different races of the same species which have been mixed together, yet it is a cumulative gain in size, as none of the wild types ever produce fruits anywhere near so large as those of the cultivated races that have been developed. Practically the entire development of the tomato has taken place within the memory of men now living, and in this case the development has not been accompanied by hybridization of different species but by the selection of different races within the species and the hybridization of these races. One of the experiments conducted by DeVries with corn is of interest in this connection. This experiment was undertaken for the purpose of increasing the number of rows of kernels on the ear, and the corn used in the selection averaged twelve rows at the time the selection began. After seven generations of selection from ears which bore the largest number of rows the mean was raised to twenty rows. In the first year of selection the variation in number of rows ranged from 8 to 20. In the seventh generation of selection the variation in number of rows ranged from 12 to 28. This shows clearly the increase in the number of rows and the development of an apparently new race by simple selection, as stated below, however, when the selection was discontinued the improvement or new character was soon lost.

The majority of new races produced as a result of selection are without much doubt due to the choice of mother plants showing marked variations which we would term mutations, and which are referred to by the gardener ordinarily as sports. In reviewing the history of cultivated varieties one is surprised at the large number of varieties which have had their origin in this way. Many of our apple, pear and peach vareties are simply accidental seedlings which have sprung up in fence corners or dooryards, and a number of our wheat, tobacco and cotton varieties have been developed by selection from certain individual plants which have attracted attention because of the exhibition of superior qualities. It is probable that a large number of these accidental and selected varieties, particularly in the case of apples and pears, are really the results of accidental hybridization, and the same may be true of many wheat, corn and cotton varieties. Yet there are many cases where the mutations or extreme variations cannot be traced back to hybridization. In the production of the Cupid sweet pease, for instance, the first small dwarf plant of this type was found growing in a row of the Emily Henderson, which is one of the normal climbing forms of the sweet pea. At that time no other dwarf type of the sweet pea was known, and this variation, therefore, cannot be accounted for as due to hybridization with some other dwarf form. It is impossible to account for these striking variations which sometimes occur, but it is important that all plant breeders be on the lookout for the occurrence of new types and variations of this sort.

The methods of selection which should be pursued in the production of new races from variations or mutations were described in the writer's paper on pedigree or grade breeding, and need not be further discussed here.

The writer has frequently been asked whether it is possible to so highly select a plant that it will not revert to the original mother type. Experience would indicate that where the mother plant from which the selection is made is a true mutation, like the sweet pea mentioned above, the type will maintain itself even after the selection has been discontinued, and indeed this is practically the only criterion as to whether a new race has been produced. For instance, in the case of corn mentioned above, which was selected by DeVries, that in seven years had been increased from 12 to 20 in the number of rows to the ear, DeVries found that it required only about three years of cultivation without selection to fall down again to the original average of from 12 to 16 rows. In a case like this it would seem, therefore, that no distinctly new character had been added as a result of selection, but the average of the race had simply been increased by the continuous selection under isolation, and that when the different individuals were allowed to breed together freely, without selection, the mean of the race, as a whole, was again quickly reestablished.

THE USE OF HYBRIDIZATION IN PLANT BREEDING.

Ever since the time of Knight, hybridization has been used extensively by plant breeders, and it seems that this is the only sure means of forcing variations. Wherever it is possible to secure distinct species and races that can be hybridized, it is possible to greatly increase the variation in different directions, and thereby afford opportunity for greater selection than would otherwise be possible. Plant breeders have come to understand that where desirable characters are exhibited by different species or races it is possible frequently, if not usually, to unite these characters in a hybrid if the work is done intelligently and on a large scale. The writer uses the term *hybrid* here in a general sense, referring to any product of a cross where the parents were noticeably distinct from each other, whether the parents belong to different races, clons, varieties or species. It may be stated that this general or broad use of the term hybrid has become almost universal in recent years. When plants of different races are crossed, as for instance, different races of wheat, corn or cotton, the hybrid usually comes nearly intermediate between the two parents in the first generation. And this is the case also when different fixed species are crossed. If individuals belonging to unfixed races, however, are crossed, there is usually a considerable variation in the first

generation. This is well illustrated by the crossing of different clons of apples, pears, oranges, &c., where the different so-called varieties are simply transplanted parts of the same individual seedling which have not been bred to a fixity of type. It is well known that if seeds of an apple variety be planted the resulting plants exhibit many different variations in the first generation. The parents themselves, therefore, not being of fixed type, when they are hybridized they produce progeny which in the first generation is variable. An illustration is afforded in the crosses made by the writer of the Trifoliate orange with the ordinary sweet orange, where the hybrids of the first generation vary in fruit, foliage and branching qualities, so that almost every individual differs markedly from every other individual of the same combination. In the crossing of races which have been bred true to type, whether of the same or of different species, the first generation hybrids are, however, nearly uniform in the characters presented, and in such instances it is necessary to secure a second generation of the hybrids in order to accomplish the breaking up of the characters and the production of a large number of variations. Ordinarily, therefore, desirable variations are looked for in the second generation. This, as has been explained above, is true only in the case of hybrids of species and races which are fixed in type.

MENDEL'S LAW OF HYBRIDS.

The preceding discussion represents fairly well the general understanding of hybrids until about 1900, when DeVries and Correns rediscovered what is now termed 'Mendel's Law of Hybrids.' While Mendel's laws or principles may not be of great value from an economic standpoint, they have proven of the greatest scientific interest, and the general fundamental principles of the law or laws should be thoroughly understood by every practical breeder of plants. It has been known for many years that a splitting up and redistribution of parental characters occurs in hybrids, and it is upon this fact largely that the practical application of hybridization in plant breeding depended. Ordinarily careful plant breeders would plan to hybridize varieties or races having a definite combination of characters in view, as for instance the combining of the fruit quality of one parent with the hardiness or drouth-resistance of the other. Until Mendel's law was discovered, however, we had no understanding of why or how such a combination could be made, and it was necessary to experiment extensively in order to determine what could be accomplished. Mendel's law includes several important features which must be thoroughly understood before its important bearings can be comprehended. One requisite for the application of the law is that the two parents possess certain characters which are opposed to each other. These two opposing qualities or characters are termed a 'character pair.' As illustrations of such character pairs may be cited bearded and bald heads in wheat, sweet and starchy kernels in corn, fuzzy or smooth seeds in cotton, and stringy or stringless pods in beans. When parents possessing these opposed or contrasted characters are crossed, the hybrid contains a combination of the potentialities representing both characters, and the first generation hybrid will thus show an intermediate form of the particular character under consideration in case the two characters are of equal strength or potency. If, however, as sometimes occurs, one of the characters is very strong or dominant only this character will show in the first generation hybrids, the other character remaining recessive or masked although present. For instance, in crossing a race of wheat having bald heads with a race having bearded heads, all of the first generation hybrids, or at least the majority of them, will have bald heads, this character being strong and dominant over the bearded character. In some instances where the potentialities of these two characters appear to be of nearly equal strength or potency the beards seem to be produced in the first generation hybrids but are reduced in length, being intermediate between the bald and the bearded state. A number of intermediate cases of this kind were shown to the writer by Dr. C. E. Saunders of the Canadian Experimental Farms. Frequently in crossing flowers of different colours the resulting hybrids will show a blend of the two colours, being, for instance, light pink when the parents crossed are a white and a red.

In other cases, however, one colour or the other becomes the dominant character, and the first generation hybrids show the colour of one parent only.

The second important principle of Mendel's law is what is termed the purity of the germ cell. It seems certain from the researches that have been conducted that when the germ cells of the first generation hybrids are formed the potentialities which represent the two different characters under consideration and which were united by the hybridization ordinarily segregate again in the cell-divisions, which leads to the formation of germ cells, so that a certain germ cell includes the potentiality of one only of the two characters. We have thus two kinds of germ cells formed with respect to this one character pair. Taking as an illustration a hybrid of wheat having bald heads with one having bearded heads, when the germ cells were formed a segregation of the two potentialities representing the two opposed characters would take place, and we would have germ cells of one kind containing the bald head potentiality and of a second kind containing the bearded head potentiality. This segregation, it must be understood, takes place in the formation of both the egg cells and the sperm cells of the pollen grains. We thus see that the first generation of the hybrid where two such characters are combined contain two kinds of egg cells and two kinds of sperm cells, so far as this one character pair is concerned.

The third important principle of Mendel's law is what is termed the law of probability, and explains what may be expected in plants of the second generation of such a hybrid. Remembering that we have formed in the first generation hybrid, as explained above, two kinds of egg cells and two kinds of sperm cells with reference to the opposed characters, what would happen if the hybrid were bred with its own pollen; or in the case of an animal, if it were bred with another hybrid of the same parentage. For the purpose of illustration, suppose that a hybrid of a bald wheat with a bearded wheat be fertilized with its own pollen and that 100 egg cells be fertilized with 100 pollen grains of the same hybrid. There are two kinds of egg cells produced, some with potentialities of the bald wheat and some with potentialities of the bearded wheat, and the same is true of the pollen grains. Taking the egg cells and pollen grains without selection, therefore, we would expect to have of the egg cells 50 with bald potentialities and 50 with bearded potentialities. In the pollen grains also we would expect to have 50 with bald potentialities and 50 with bearded potentialities. If these are brought together, allowing the law of chance to govern the union, the probability is that we would have 25 bald uniting with 25 bald; 25 bald uniting with 25 bearded; 25 bearded uniting with 25 bald, and 25 bearded uniting with 25 bearded. Representing the bald potentialities by *B* and the bearded potentialities by *b*, we have the following formulae which explain the probable unions graphically:—

One hundred egg cells x one hundred sperm cells.

25B x 25B = 25BB } (These do not contain potentialities of *b*, and will reproduce true.)

25B x 25b = 25Bb } (These are hybrids so far as this character pair is concerned,—exactly the same as in the first generation, and contain potentialities of both *B* and *b*. These will not reproduce true to type, and will break up like second generation hybrids.)

25b x 25B = 25bB }

25b x 25b = 25bb } (These do not contain the potentialities of *B*, and will reproduce true.)

The above illustration will explain the law of segregation, and probable ratio of recombination when hybrids are inbred with their own pollen, and when only one pair of characters is considered. When an egg cell with bald potentialities unites with a sperm cell with bald potentialities this gives rise to a pure germ cell containing only

Fig. 1.—Isolated patch of a Hybrid Cotton before rogueing.

Fig. 2.—Isolated patch of a Hybrid Cotton after rogueing. (Same plan as shown in Fig. 1.)

bald potentialities, and the progeny in subsequent generations will breed true so far as this character is concerned. Also where the egg cell with bearded potentialities unites with a sperm cell with bearded potentialities the result is a pure germ cell containing only bearded potentialities, and the progeny would reproduce true, so far as this character is concerned, in subsequent generations. In the other two cases, wherein fecundation germs with bald potentialities unite with germs with bearded potentialities, giving the combinations *Bb* and *bB* which amount to the same thing, we have in reality hybrids exactly the same as in the first generation, and the progeny from these in the next generation behave exactly the same as did the first generation hybrids in the second generation. In such a case as this, where one of the characters, as the bald head is strong and dominant, all combinations that contain the potentialities of this character, whether pure or mixed, show this character only. Thus in the above table the 25bb would come with bearded heads while the 75 of other combinations would have bald heads. To determine which of these 75 were as the combination Bb, that is bald with bearded, and which BB, that is bald with bald, would require the growing of progeny to determine which were reproduced true to type. The ratio of the combinations, it will be noticed, is 1BB to 2Bb to 1bb. While in certain hybrids of parents possessing two opposed parental characters this ratio of probabilities is not produced, if large numbers are used the ratio will be found in many cases with little deviation. A sufficiently large number of cases have now been carried out with various plants and animals to place the conclusion beyond question. We do not know, however, how many characters follow Mendel's law, and are not yet entirely certain, for instance, whether those character pairs that sometimes follow the law of segregation always follow it.

The individuals of the second generation which contain the potentialities of both characters of the pair, if self-fertilized or bred with similar individuals containing the potentialities of both characters, exhibit in the third generation exactly the same nature that first generation hybrids exhibit in the second generation. The two potentialities are commingled in their cells, and to all intents and purposes they are exactly the same as first generation hybrids. When such self-fertilized hybrids are grown they give again in the third generation the regular Mendelian proportion of 1BB to 2Bb to 1bb. Here the individuals containing only potentialities of one character, that is. BB and bb, would come true to these characters in succeeding generations, while those individuals containing the potentialities of both characters Bb would be expected to appear again in the fourth generation in similar proportions.

When we deal with more than one character pair the matter becomes more complicated, but will become clearer upon careful study. If we combine with the above characters the character of hairy (*H*) and smooth (*s*) chaff in the head, and remember that the potentialities of these two characters in the hybrids segregate exactly as in the case of bald and bearded heads, we can foretell what will occur. In this case the hairy chaff is the strong dominant character, as in the first generation hybrids of hairy with smooth sorts the chaff is always or very generally hairy. We would thus represent these characters by *H*, for the hairy or dominant character, and *s* for the smooth or recessive character. In this character pair we would expect a splitting and segregation to have occurred in the formation of the germ cells of the first generation hybrids, so that the hybrid plants of the second generation would exhibit these characters in Mendelian proportions, as in the characters described above. The progeny in the second generation would thus exhibit these characters in the following combinations and proportions: 1BH to 2Hs to 1ss. This probable proportion should hold rather constantly either in small or large numbers of hybrids, though in large numbers it would probably be more accurately realized. The potentialities of the four characters, or two character pairs, are commingled in the cells of the first generation hybrid. When the egg cells or pollen grains are formed, however, a segregation of the potentialities of the two character pairs occur but independent of each other. Each egg cell or pollen grain will receive only the potentiality of one character of a certain character pair, but will at the same time receive potentialities of other characters belonging to other character pairs. Considering the two character pairs described, an egg cell receiving the

potentiality of the bald head (*B*) might contain the potentiality of either *H* or *s*, representing the characters of hairy or smooth chaff. These two character pairs would thus give us egg cells of four combinations, namely, *BH, Bs, bH* and *bs*.

In the formation of the pollen grain the same combination occurs, so that with reference to the two character pairs described the pollen grains that would be formed have the same combination of potentialities as the egg cells, namely, *BH, Bs, bH* and *bs*. We thus have four kinds of egg cells and four kinds of pollen grains, so far as these two character pairs are concerned. If these are brought together, sixteen combinations are possible as follows:—

BHBH	BsBH	bHBH	bsBH
BHBs	BsBs	bHBs	bsBs
BHbH	BsbH	bHbH	bsbH
BHbs	BsBs	bHbs	bsbs

Examining these combinations carefully, and cutting out the letters that occur twice, as the occurrence of the same potentiality in both egg cell and pollen grain serves only to reproduce the same character, we have the following nine combinations, all of which are different: 1BH, 1Bs, 1bH, 1bs, 2BHs, 2BbH, 2Bbs, 2bHs and 4BbHs. In the illustration taken of the character pair of bald and bearded heads, and the probable ratio of unions in second generation hybrids, it was shown that out of 100 unions we should expect by the law of chance the ratio 25B to 50Bb to 25b. Now, considering the second character pair, that is, the hairy and the smooth chaff, in connection with these same 100 unions, we would have the following as the probable combinations, according to the same law of chance:

25 B.		50 Bb.		25b.	
25 B	6¼ BH	50 Bb	12½ BbH	25 b	6¼ bH
	12½ BHs		25 BbHs		12½ bHs
	6¼ Bs		12½ Bbs		6¼ bs

These nine combinations are the same as the nine given above, only multiplied by 6¼ in each case. In each of the nine combinations where only one of the potentialities of the character pair is present the progeny from such an individual from self-fertilized seed will come true to this character in all succeeding generations, as the potentiality of the opposed character has been eliminated. Thus in the first combination BH, representing the potentialities of the bald head and hairy chaff, if such a hybrid is fertilized with its own pollen it will produce only progeny with bald heads and hairy chaff. In the second combination BHs we have present the potentialities of the bald head of one character pair and both the hairy and smooth chaff of the other character pair. Self-fertilized progeny of this hybrid should all come bald, but some should have hairy chaff and some smooth chaff. In the third combination Bs we have present simply the potentialities of the bald head and smooth chaff, and such a combination should give plants that will come true to type in later generations when self-fertilized. Similar conditions of purity or hybridity of the germ cell can be figured out for each of the other six combinations.

If a third character pair were considered, the proportions of the combinations can be determined in exactly the same way. Each one of the above nine possible combinations would be again divided into three different unions in the same way as the three combinations of the one character pair gave nine different combinations in the second character pair. In the consideration of the three character pairs there would thus be 27 different combinations of parental characters. And again in each ovary fecundated, where only one potentiality of each character pair occurred, the opposing character potentiality being in each case eliminated, such a cell should give a plant which would reproduce its characters true to type. It is well known that almost any two different races or species which may be chosen for hybridization will ordinarily differ from each other in numerous characters. Where there are a number of these opposing characters

which form Mendelian character pairs, the determination of the possible combinations by Mendel's formulae becomes very complex and difficult to understand. It is only by taking a few well marked character pairs and carefully studying them that the segregation and new combinations according to Mendelian proportions can be followed and understood. Any character pairs, following Mendel's law, would segregate as indicated above in the case of bald and bearded heads and smooth and hairy chaff of wheat. These characters with wheat have been investigated by Spillman, Hurst and others, and are known to very closely follow Mendelian proportions in their segregation, and Dr. C. E. Saunders, in charge of the wheat experiments at the Canadian Experimental Farms, has recently shown the writer plots of hybrids which had segregated very nearly to the Mendelian proportion so far as these two character pairs are concerned. The same segregation takes place in the case of the bald and bearded barleys, smooth and fuzzy seeded cottons, sweet and starchy kernels in corn and many other opposed characters in plants.

It is by no means probable that all characters follow Mendel's law of segregation and recombination, and secondary characters in practical work need be given no attention. The knowledge of Mendel's principles may not greatly change the practical methods of breeding which have been followed for a number of years, but they give us a more thorough comprehension of what we are doing, and also greater surety that certain combinations of parental characters can be obtained.

THE USE AND FIXATION OF INTERMEDIATE OR BLENDED TYPES.

The principle of the purity of the germ cell, if strictly applied, would not recognize as possible the fixation into a race reproducing true to type of an intermediate hybrid, that is, one in which two characters of a certain pair are blended. Yet practical work shows that such a fixation certainly can be obtained. In very many hybrids of plants cultivated for their flowers intermediate colours have been bred to stability, showing that the inheritance is blended. The writer has been attempting to fix a hybrid of Black Mexican sweet corn having blue-black kernels with Stowell's Evergreen, which has a nearly white kernel, into a race of light blue violet colour, and strictly intermediate in this respect between the two parental varieties. Ordinarily the colour of these hybrids breaks up in Mendelian proportions, but neither colour can be considered to be dominant in the true sense of the word. In practically all cases where the potentialities of the two characters are mixed in the same egg cell, the colouration is intermediate rather than like one or the other of the parent varieties. The writer has uniformly selected the seed of such intermediate, light blue violet kernels for planting, and has kept the patch thoroughly isolated. After four years of such selection a type which produces nearly uniformly light blue coloured kernels has been produced. There are still a good many reversions to the colouration of either parent, but these are growing fewer, and the writer feels certain that such an intermediate colouration can be fixed into a stable race, reproducing itself true to seed. Dr. Byron D. Halstead, of the New Jersey Agricultural Experiment Station, has produced such an intermediate coloured race by the hybridization of Black Mexican with the Egyptian, and has already secured a new race which is practically fixed in its intermediate colour. The writer believes that in this and in a great many other cases it is possible by careful selection of plants showing the intermediate type to breed new races that exhibit a blend of characters, and such blends are frequently of great value.

The work which has been carried out by the writer in the Department of Agriculture in the breeding of citrus fruits very clearly indicates what valuable intermediates may sometimes be obtained. One of the principal difficulties in the growing of oranges in Florida and other parts of the United States is that the trees are frequently damaged severely by cold. In the great freeze of 1894-5 almost every orange tree in the State of Florida was frozen to the ground, causing a loss of ten years in the development of the industry, and a financial loss of nearly $75,000,000. This freeze served to emphasize the fact that the great desideratum was more hardy varieties of oranges that would

withstand freezing. A careful consideration of the matter showed that this hardiness very probably could not be secured by selection at least within a reasonable time. Such damaging freezes had occurred very frequently in Florida and other citrus growing countries, and from the time orange growing started, growers had been watching and selecting hardy types, yet with all of this selection, extending to an examination of many millions of trees, no marked advance had been made. The only feasible method thus seemed to be to hybridize the common sweet orange with some hardy type of wild orange. We have such a hardy type in the Trifoliate orange, which was originally imported into America from Japan. This plant is deciduous and produces a fruit about 1½ inches in diameter, which is very seedy, sour, gummy and inedible. It is very hardy, however, growing successfully as far north as New York. The writer, in conjunction with Mr. Walter T. Swingle, of the Department of Agriculture, hybridized the Trifoliate orange with several varieties of the sweet orange, and as a result at least three different varieties of hardy oranges have been produced. These hybrids are nearly intermediate between the two parents, having the characters in the first generation nearly blended. The leaves are trifoliate, but are much larger than the leaves of the ordinary Trifoliate orange tree, and show a tendency to drop off the lateral leaflets producing a unifolilate leaf. The Trifoliate orange is deciduous, while the sweet orange is evergreen. The hybrids are semi-deciduous, holding a large share of their leaves through the winter. In hardiness they also seem to be intermediate, being much more cold-resistant than the ordinary orange, but not as hardy as the Trifoliate orange. They are sufficiently hardy so that they may doubtless be grown with safety as far north as South Carolina, or from 300 to 400 miles north of the present orange region. Some of the fruits produced are as large as the ordinary orange, but the majority are very nearly intermediate in size. They are very variable, however, in the first generation, and at least three of the fruits which have been produced are quite juicy and valuable. All of these hybrids thus far fruited are nearly seedless. Three of these new fruits have been named and two of them have already been distributed to growers in sections north of the present orange region. From the fact that they are different from the sweet orange and from the Trifoliate orange, occupying an intermediate position, and being dissimilar to any fruit now existing, they have been termed the 'Citrange.' The three hybrids above mentioned are in general intermediate in type. It is not probable that they would be reproduced true to seed, but orange varieties are clons, and the different types will of course be normally reproduced by buds or grafts, so that from a practical standpoint it does not matter whether or not they would reproduce true through the seed. In the second generation it is probable that these different characters would split up, possibly according to Mendel's law, and it is likely that still more valuable varieties will be obtained when the second generation has been grown. Similar groups of valuable intermediate types of fruits have been produced by Doctor Saunders, the able Director of the Canadian Experimental Farms, by crossing varieties of the ordinary apple, such as the Pawaukee and Wealthy, with a very hardy, cold-resistant type (*Pyrus baccata*). Doctor Saunders has already produced numerous hardy intermediate types which bid fair to be of very great economic value.

THE COMBINATION OF DIFFERENT PARENTAL CHARACTERS NOT BLENDED.

The greatest value of hybridization in the production of new varieties lies probably in the possibility of combining in the new race certain valuable characters of different races or species. This principle breeders have long recognized, but it cannot be too clearly borne in mind. The work which the writer has carried out in the Department of Agriculture in the production of long staple varieties of upland cotton forms an interesting illustration in point. Ordinary upland cotton, which is grown all over the interior cotton regions of the south, produces a short fiber averaging about one inch in length. In the eastern part of South Carolina, southern Georgia, and northern Florida, Sea Island cotton is grown. This coton has a fibre from 1¾ to 2½ inches in length. Ordinary upland cotton has an average value of eight or nine cents per pound,

while this longer staple Sea Island cotton is ordinarily worth from twenty to thirty cents per pound. Other things being equal, a longer fibered cotton is always more valuable than a short staple, and were it possible to obtain the same yield it would be far better to grow long staple cottons altogether. The Sea Island or long staple cotton, however, has a small three-parted boll which opens very poorly and is difficult to pick, and yields much less than does upland cotton. Upland cotton, on the contrary, produces large rounded bolls which open wide and are easy to pick, and yields much more heavily than Sea Island. Sea Island cotton has a smooth black seed, so that roller gins can be used in separating the seed and fibre, and this is an important consideration with long staple cotton, as the saw gin tears and breaks the fiber. With the short staple or upland cottons the seed is covered with a short close fuzz, and they are uniformly ginned on a saw gin. The tearing of the fiber which necessarily results to a considerable extent, does not matter greatly with a fiber of this short length. If longer stapled varieties are desired they should have smooth, black seed, so that a roller gin can be used. The writer undertook experiments in the hybridization of these two kinds of cotton, in the hope of producing a new race which would inherit on the one hand the large bolls, tendency to yield heavily, and adaptibility to upland regions, of the short staple or upland cotton, and on the other hand, the long, fine and strong lint and black seed of the Sea Island cotton. The first generation hybrids were found to be nearly uniform and showed little breaking up of characters of the two parents. In the second generation, however, all manners of types were formed, exhibiting the characters of the two parents in very different degrees. Out of several thousand second generation hybrids several individuals were selected which showed almost exactly the combination of characters which it was desired to produce. These hybrids were self-fertilized the next year, and each one was planted in an isolated patch in order that they would be fertilized only with pollen of related progeny. Each generation since only those plants have been selected for seed which come the nearest to the original type, and now after five generations of selection two or three of the types have been bred to a practical state of fixity, showing the possibility of combining in a hybrid valuable characters from distinct parents.

FIXATION OF HYBRIDS.

When different types have been crossed and hybrids secured which possess the characters desired, it is necessary that careful methods of selection and breeding be followed in order to finally secure a type that will transmit its qualities. The great majority of such hybrids when first produced will not reproduce true to type. The policy followed by the writer in the cotton experiment above referred to, will usually serve as a good guide in the fixation of any hybrid. The hybrids if self-fertile should in most cases be fertilized with their own pollen in order not to introduce any new hereditary tendency unless it is found that such fertilization too greatly reduces the vigour. In cotton self-fertilization has been found not to decrease the vigour of the plants, and the same is true of wheat, tobacco, oats, and plants that are normally self-fertile to some extent. In the case of corn it has been found that the inbreeding of a plant with its own pollen results in a great deterioration in vigour, and here it is the best policy to cross the desired hybrid with another hybrid having the same characters. The seed of such select hybrid plants should then be planted in isolated places so that the plants will not be crossed with the pollen of either parent or other varieties. When the progeny of these select hybrids reach a point where their characters become visible it may be desirable to weed out the undesirable plants that are off type, in order that the plants which most nearly resemble the type desired will be fertilized with pollen from similar plants. In the writer's cotton experiments the seed of each individual selected plant of the second generation was planted in a small isolated plot of about one acre. As soon as the plants began to show their characters and it could be recognized that certain ones had not inherited the desired qualities, the fields were carefully searched and all plants not true to type were pulled up, leaving only a few good plants of the right type. This insured that all of the later bolls formed would be fertilized

with pollen from similar plants of good type. The process of weeding or rogueing is illustrated in Plate II. Each subsequent generation the select plants should be grown in isolated plots and seed selected only from those plants which have reproduced the ideal type for which the breeder is working. The time required to secure fixed types is quite variable, but in wheat and cotton, where careful experiments have been carried out and recorded, the indications are that from four to six generations are ordinarily required to reach a fixed stage. This does not mean, of course, that all variation is prevented, but that the hybrids have been bred to the same type as nearly as is the case with any ordinary race of variety.

SELECTION OF VEGETATIVE PARTS.

Space will not permit of a thorough discussion of this subject, but no consideration of methods of plant breeding would be complete without a mention of the improvements which can be produced by what may be termed the selection of vegetative parts. While in general all buds of a plant are practically the same, as is shown by the fact that buds taken from the Baldwin apple almost uniformly produces Baldwin apples, yet there is considerable variation frequently in the product from different buds, and it is well known that we have a class of variations which we have come to call bud sports. In violets, for instance, the propagation is normally by slips which are developed from different buds. These slips when grown into plants, frequently show considerable differences, and Dr. B. T. Galloway and Mr. P. H. Dorsett, of the Department of Agriculture, have demonstrated that by the selection of slips from plants which are very productive, the yield in the number of flowers to the plant can be considerably increased. In the case of the orange, seedling trees are almost always very thorny, yet certain branches may show a tendency to be more nearly thornless, and by the selection of buds from such branches, the thorny character of almost all the standard varieties has been reduced. By the systematic selection of vegetative parts, such as buds, slips, suckers, &c., in many cases quite important improvements could doubtless be obtained, and the plant breeder should have a thorough understanding of this method of improvement. In hybrids of mixed parentage frequently a bud on one side of a plant will sport, showing different tendencies, and some of our new varieties of roses, chrysanthemums, &c., have been produced by the selection of such bud sports.

SOME COMMON PRINCIPLES WHICH UNDERLIE IMPROVEMENT IN ANIMALS AND PLANTS.

(By J. H. GRISDALE, B. Agr., *Agriculturist, Experimental Farm, Ottawa.*)

Mr. President and Gentlemen,—When informed some time ago by our secretary, the Seed Commissioner that I was to read a paper on 'Some common principles which underlie improvement in animals and plants,' I rather reluctantly undertook the task, and I hardly think what I have written will be of much value to our Association. However you shall have it for what it is worth, as I think it may possibly be of some use to the beginner, to the everyday farmer, rather, than to the man who has made a life study of the great problems which confront us in plant improvement. But even scientific men are, in both Canada and the United States, sometimes forgetful of some of the elementary principles underlying plant evolution or plant breeding, and if by chance any of them happen to stumble across this paper they may have their great minds turned to other channels for a few minutes.

Plant life preceded animal life, yet I think I am safe in asserting that man directed his efforts to the improvement of animals long years before any thought of studying plants with a view to their improvement occurred to him. In any case we

have records of the skill of ancient animal breeders in modifying, if not the form, at least the colour of their animals to suit their own ends. It is quite evident, therefore, that the study of animal breeding must have been an old and much practised art even in the days of the patriarchs.

Plant breeding has no doubt been studied for a much longer time than many of our present day experts in that science would like us to believe; or, probably, I had better say, longer than many of the biographers or article writers of the present day who devote their attention to writing up the history of the work of such men would have us believe. For, I think we must all admit that more or less improvement takes place with either plants or animals the moment they come under care and cultivation.

Under wild conditions the struggle for existence is the chief factor in determining the line of change or modification in form, habit or quality. The moment the struggle for existence is eased to any considerable extent opportunity for variation in other directions is offered, and improvement becomes possible.

Life, whether that of animal or plant, struggles along under the most adverse conditions. Improve the conditions, and at once powers and qualities not previously suspected show themselves, and are possible of great development provided always that conditions are favourable.

To illustrate, animals have been selected from herds badly fed, badly housed and cared for, animals that had not previously been known to do anything at all remarkable in the way of milk production, or had not been at all noted for fine appearance, good style or any other valuable characteristic, and these animals have been known to develop with good feeding, good care and good management into superior dairy cows, prize winning horses, famous sires of beef cattle or great sheep.

So with plant life, the half or even a greater proportion of the fame or value of a variety of grain depends upon the conditions under which it has been produced. Make these adverse and the returns are sure to be limited and the quality inferior. Let the conditions of growth be favourable, however, and the possibilities are almost beyond one's highest hopes.

The average return of the oat crop in Canada is somewhere around 25 bushels per acre. Some oat crops must have barely returned the seed, and quite possibly some did even less. Some fields I have seen have given as high as 136 bushels per acre, and I have heard of even higher yields. This wide difference is due, not to the seeed, but to the conditions under which it was asked to grow. That is, conditions as to soil have so much influence on the crop returns as to change these returns from a bare handing back of the seed to a crop of from 60 to 80 fold. Further, the effect of favourable soil conditions is not limited to increasing the returns, but also brings out unsuspected qualities of a grain, qualities which of course are not always such as we like, nevertheless qualities which must receive our careful attention for perpetuation or elimination.

It seems to me that a brief consideration of the conditions which go to make for the greatest crop returns so far as the soil is concerned, might justly receive some consideration at this point.

Good cultivation is undoubtedly the first thing to consider, and by good cultivation is meant proper ploughing, sufficient harrowing and cultivation at the right time and under the most favourable conditions as to moisture, &c., to insure a good seed bed.

Another factor which very materially affects soil condition, but one which is neglected too frequently in Canada, is drainage. Undoubtedly more poor crops may be attributed to imperfect or inadequate drainage than to any other single cause. If this Association could see its way clear to require that all fields devoted to the production of good seed should be thoroughly drained, many of the yields recorded per acre would guarantee the producers a ready sale, and bring the name of this Association into high repute for the quality of the seed produced by its members.

Drainage has also a most beneficial effect upon the physical condition of the soil, which is of course also improved or aided to a large extent by cultivation. But in the case of heavy soils in two years out of three it is practically impossible to get the seed bed into perfect condition unless a thorough system of drainage be in operation.

The proportion of vegetable matter in the soil will also materially affect its physical condition, hence the importance of seed growers not neglecting the following of a good rotation on such lands as they decide to devote to commercial seed production. In the regulations of the Association, Section 29 reads: 'To entitle the seed of wheat, oats, barley, maize and flax to be eligible for registration by the Canadian Seed Growers' Association, it should be produced on a well cultivated seed plot from a crop that has followed in rotation after:—

(*a*) Clover, pease, beans or some other leguminous crops;

(*b*) A cultivated crop, such as Indian corn, turnips, mangels, carrots, beets or potatoes;

(*c*) A summer fallow; or

(*d*) Sod;

Showing that the framers of the constitution were conscious of the importance of good physical conditions in the lands devoted to seed production.

For eastern Canada it seems to me the ideal rotation for seed grain production would be first year clover hay, second year corn or roots with manure, followed by third year grain, seeded down with clover to be left one year in hay or pasture.

EFFECTS OF ROTATION.

In soil properly drained, well cultivated, and in good physical condition there is very seldom a lack of plant food, and crops grown thereon almost invariably give good returns. Where barn yard manure is applied some place in a short rotation, and a clover sod turned under, there need never be any fear of a lack of plant food.

A FEW REMARKS ON CULTIVATION AND FERTILITY, AND WHY GRAIN FARMERS SHOULD BE LIVE STOCK MEN.

Crops grown under such conditions as I have described above may be said to have been well cared for, well fed and well watered, if terms used in connection with animals may be admitted. Plants so treated, just as animals so treated will do the very best that is in them. Until we know the best that can be done by an animal or plant, by a herd or crop under the most favourable conditions it is useless, or at least of much less importance to strive to improve by selection, or by taking advantage of variation.

But a word of warning or caution should be given here. A plentiful supply of food is necessary and has a good effect. A superabundance is injurious and militates against success with either plant or animal. Especially is this the case if food unsuited for the purpose in view be fed, that is, to our animals we give rations suited to the service we ask of them. Our plants must be treated quite as wisely. To sow grain on a clover sod with which a dressing of manure has been turned under would be to give to the crop an over supply of stalk and leaf-forming food, when what we really need is an abundance of seed-producing food. The clover sod with manure is an ideal preparation for ensilage-corn or for roots, when a ration suitable for leaf and stem and root production is needed. The condition of such a soil the next year after the crop of roots or ensilage corn has been harvested is much more likely to prove suitable for grain production, since the greater part of the readily soluble nitrates will have been utilized or carried off and the less soluble, more slowly available phosphates be, in proportion to the nitrates, more suitable for seed or grain production. In brief, the plant is as desirous of, and as ready to take advantage of a balanced ration as is the animal. True, it is not so easy to control the proportions in which the chief elements of plant food shall be found available in the soil at a given time, but study and experience will gradually teach us what to expect from a given field under given conditions.

In addition to the good effect that a plentiful supply of food under favourable conditions has upon the returns from, and quality of animals and plants, another result is usually noted and that is the emphasizing of differences between individuals of the herd or crop and the accentuating of peculiarities. Every animal has an individuality of its own. Every plant differs more or less from every other plant. Favourable soil

conditions by encouraging the further development of minor differences permits of the closer study of the individual plant and the selection and perpetuation of such peculiarities as appeal to the breeder. I know from work in animal breeding that unless favourable conditions as to food and care are insured the breeder cannot hope to make a success of his efforts toward improvement. I feel, therefore, that I am perfectly safe in saying that unless favourable conditions, in fact the most favourable soil conditions maintain much of our work toward plant improvement be it as a private enterprise or as a public supported effort must prove abortive or yield inadequate results.

Once the breeder has done the best he can by whatever he is using, which will of course, to start with, be the best procurable, he will naturally select with the utmost care for future operations such individuals as come nearest his ideal.

This line must be followed whether animals or plants are being operated with, and is, I think, the line which will in the future, as it has in the past, give the best results.

NOTE ON BREEDING.

Innumerable examples in both animal and plant history could be cited to show that this principle is common to the two great classes of living organisms, but I shall cite merely two well known cases, the use of the little red bull Hubback by the Collings in improving or even, we might say, in establishing, the Shorthorn breed of cattle, and the selection of the single plant from which our famous and apparently unsurpassable wheat, Red Fife, was started. Selection and the use of the best available was, in either case, the key to success.

Another point where animal and plant breeders agree is in the lines of improvement they follow.

Fecundity or prolificacy or fruitfulness is an invariable requirement of all successful breeding operations. The plant breeder is probably somewhat more exacting in this respect than is the animal breeder, but both make it a *sine qua non.*

Quality, which with the animal breeder stands at the top, has until quite recently been a minor consideration where cereal or grain breeding was concerned. I believe it will, with some grains at least, replace very largely the importance attached to heavy yields. Evidence of this is afforded in the efforts that have been, and are being so successfully made to improve the quality of sugar beets, corn and wheat, to say nothing of improvements in the quality of fruits.

Precocity has in the eyes of certain classes of animal breeders a very high value. The strides that have been made in this direction are truly wonderful. Plant breeders are but recently awaking to the value of precocity in their subjects. In southern latitudes these breeders are not so anxious to shorten up the time from sowing to harvesting, but to this characteristic we in Canada must pay close attention. Here again we have a comparatively new field for plant breeders, and precocity or early maturity is a quality quite capable of improvement by selection, a characteristic which is certainly worth developing, and a field where little has been done.

Economy of production has always attracted the animal breeder. It is also of the very highest importance to the plant breeder, but fruitfulness and economy of production are practically inseparable in plants, although quite distinct qualities in animals. Quality must, however, receive more consideration in the future as a factor in economy of production just as it must also receive greater attention when selecting for fruitfulness.

Size is probably as easily changed a characteristic in both animals and plants as any breeder can set out to work with. Great size, however, is in many classes of animals and plants of no particular value. This is particularly true for the reason that as generally the case with both animals and plants, very large individuals usually lack quality. Increased size with quality is what we want.

To summarize, I think I may say without fear of contradiction:—

1. That animal and plant breeders are at one in trying to improve the different species with which they work as to quality, fruitfulness, precocity, economy of production and size.

2. That the possibility of improvement in both cases is dependent on variation or differences in characteristics, and the selection of individuals whose characteristics please us to use in breeding others, on the assumption that 'like begets like,' or as we often hope and sometimes realize, 'good may beget better.'

3. That to succeed in our breeding operations we must afford our subjects the very best conditions for growth, development and reproduction.

THE SEEDSMEN AND THE CANADIAN SEED GROWERS' ASSOCIATION.

(By Mr. S. E. Briggs, *Toronto*).

Mr. President.—I am indebted to your kind courtesy for being present with you at this, your second annual convention, and for the invitation extended me to address you on the subject, 'The Seedsmen' and 'The Canadian Seed Growers' Association,' and hope I may be so fortunate as to offer some suggestion that may help you in the carrying on of the work which you have undertaken, to a successful end.

To some of you, the interests of the seedsman and your association, may seem somewhat divergent, but when carefully considered, it will be found they are very closely allied.

The business of a seedsman requires a highly trained, technical education to become thoroughly competent, and is one of the most important branches of trade within our midst. The chief products from the soil are grown from seed, much of which is supplied by the seedsman.

The kinds and varieties in the vegetable kingdom are many. Their seed must be grown under varied conditions and climates, that their highest state of development may be attained, so that they may re-produce their kind when planted and grown under differing conditions, suitable for food purposes.

There is no one climate, state or country, where the many varieties of seeds which we use, can be produced successfully. The seedsman must know where his supplies can be most perfectly grown that they may be suitable, as upon him the user places his trust when securing seed requirements.

The reliable seedsman fully realizes the loss and disappointment the planter experiences, whether from uncontrollable causes, or from using inferior quality of seeds; he must strenuously and continuously apply his knowledge and critical skill in selecting and improving his seed supplies, and only under such conditions of seed growing can high class stocks be obtained.

Any seed varies in the quality of its product according to the care and conditions under which it is produced, just the same as the ordinary farm crop, and equal care should be given when purchasing any seeds that you would give if purchasing a high bred 'pedigree' animal for improving your live stock. We must not overlook the law of nature 'like produces like.'

I am pleased to say that the educational work which the Seed Branch of the Department of Agriculture has been doing, for the past few years, is being felt and appreciated by the seedsmen. The demand for better quality in seeds is annually increasing, and I trust that ere long, the 'cheap John' dealer, in low grade seeds, will soon require to turn his attention to other lines of business; he is not only a detriment to the best interests of the country, but brings discredit and injury to the legitimate seed trade. However, I have no hesitation or fear of contradiction in saying, that we have seed houses in Canada, as reliable as any in America.

Having spoken of the seed trade generally, we may consider it more specifically, and upon ground in which we are individually interested.

Canada is not adapted to producing many seeds of a biennial nature, for the reason that our winters are too rigorous and our growing season too limited. Roots and bulbs of a biennial nature may be preserved through the winter by storing in properly prepared, frost-proof cellars, but the lateness of our planting season in spring, together with the early frosts and cool, damp weather in autumn, prevents the seed from developing and maturing, and in consequence the product is worthless for seed purposes. Success may be attained should the season prove favourable, but the risk and expense has been found, from practical experience, so great, that such seed growing in Canada is quite impracticable, as a commercial enterprise. We have, however, a soil and climate which is especially adapted to growing 'cereal crops,' clover and timothy, and a territory of such vast magnitude, that our possibilities are almost beyond comprehension. With such a future to develop, we must not be indifferent to the fact that 'we can reap only that which we sow,' and to fully realize our highest expectations, a better quality of seed wheat, oats, barley, pease and other staple farm seeds is greatly desired.

Few of you may be aware of the difficulties that the seedsman experiences in collecting his requirements in seed grain of all varieties. With the utmost vigilance and care, it is becoming more difficult each year to find true, clean, desirable samples for use as seed. The past year has been no exception, but on the contrary has been the most trying season yet experienced, not only in finding pure, clean stocks, but owing to the past unfavourable growing season, samples have been shrunken, poorly developed, mixed with foul weeds, very difficult to clean, thus causing heavy waste and loss. With the most diligent care these could not be brought to a satisfactory condition for seed purposes, nor can desirable seed stocks be readily obtained, even with a favourable season for growing. Quality is wanting. There is a great need for improved seed stock.

The Department of Agriculture has expended large sums of money, annually, for some years past, in procuring wheat, oats, barley, pease and other cereals, from every known part of Europe and America. They have grown and tested these upon the Government farms. When anything has shown fair merit, it has been distributed over the Dominion in small packages 'free to all who apply,' the country paying the expense. After the many years of this annual free distribution, has the farmer derived any benefit commensurate with the cost, either in increased crop returns, or in improved quality of the product? There is a wide and growing opinion that the system of 'free' distribution of these packages of seed, by the Government, is a waste, and that little, if any known good has been accomplished. It has demonstrated the principal that 'What may be had for the asking gets but indifferent attention.' Many excellent varieties of cereals have undoubtedly been thus sent out, but unless the man has a monetary interest in the article received, the purpose and object is lost. What is most needed to improve our agricultural products, is an intelligent and interested consideration on the part of our farming population, as to how the largest returns from the soil may be realized with the opportunities at their command.

From what I have learned regarding the purpose and work for which the Canadian Seed Growers' Association has been created, and of the system it has adopted for improving the seed stock of cereals, it will, by faithful and continued attention, do more towards increasing the yield, quality and value of our staple farm products than any other method heretofore introduced, and will make seed growing a paying undertaking to every producer who, by perseverance and care, brings to the highest perfection any variety of grain which he may choose for improving by continued selection.

Professor Robertson has earned for himself the highest praise that can be accorded him by the farming population of Canada for having demonstrated to them, by actual process and results, how any grower may improve his own seed stocks. It now remains with the individual to apply it.

Feeling assured that very many enterprising growers throughout the Dominion will enter into the work of improving some one or more varieties of grain for seed,

may I suggest that they first consider and select only such varieties for improving that are likely to prove worthy and suitable for general use. The original name of a variety should be retained, and all local or new names avoided, as they might not only prove confusing, but a disadvantage to the grower, as old and familiar sorts are invariably in greater demand than new and untried varieties. Many varieties which were at one time in high favour have, from indifferent attention, deteriorated in yield and quality. These may be renewed and again made profitable for growing by applying the system of selection.

After the grower has given sufficient time and care to improving any variety, and his stock has passed a favourable inspection by the officer in charge, he receives a 'pedigree' certificate, which qualifies that stock for growing as a general crop. The product of such crop can then be offered and sold as a high class 'pedigree' seed stock.

Many of you may soon have a surplus of this 'pedigree' product to offer. Have you considered 'ways and means' for distributing this product, so that the greatest good may be derived and the greatest number may be enabled to secure improved seed? This is the business end of the enterprise, and what I may say regarding this side of the question is with no personal object or motive in view, but in the best interest of the producer and user. I read a paragraph in *Saturday Night* a few days since, headed 'What he didn't know,' which may better explain my meaning:—

'A retired Irish major sold his horses and carriage and bought a motor-car, but instead of engaging an experienced man to run the machine, he decided to send his coachman to a firm of engineers for a course of lessons.

'"You will go through a two months' training," he explained to Pat, as he handed him a cheque for his expenses, "during which time you will make yourself thoroughly familiar with the engine and all its works."

'"Yes, sor," said Pat.

'"You will note every wheel and crank, and learn what they are for and what they have to do, so that when you return you will be equal to any emergency."

'"I will, sor," said Pat; and having stowed the cheque away down in his trouser's pocket he took his departure.

'In two months' time he returned, with the conqueror's look in his eye.

'"Well, Pat, have you succeeded?"

'"I have, sor."

'"And you know everything about a motor?"

'"I know all, sor, from the big lamp in front to the little number behind, except one thing," Pat added nervously.

'"And what is it you don't know," demanded the major.

'"Well, I don't quite understand yet what makes the blessed thing move without horses."'

You, as with the Irish major, have invested in an enterprise which requires experience to make it go. Have you decided upon the engineering skill required to move your product?

The Department of Agriculture has supervised and controlled the work, up to the present time, for which your Association has been formed, and may wisely continue its support, purely in an educational way and in supervision, but could not in justice to or in competition with any established section of commerce enter into the commercial part of the enterprise. Your Association must of itself devise ways and means for operating and marketing the products which you expect to sell. The most important part of the undertaking to you is its commercial success, as few of you would enter into the work unless you had in view something tangible in the way of profit to repay you for your long and weary toil and expense from year to year.

Enterprising growers have from time to time undertaken to grow some special variety of grain for seed, and to sell direct from their farm to users. They have been obliged to incur heavy expense in issuing printed matter, advertising, &c. Orders are received, with promises to pay on arrival of goods; shipments are sent to all parts of the country, and when the grower has sent out his crop he finds many purchasers have

not paid, and in many instances cannot collect what is due him. His enterprise has resulted in loss, he quits the business, and now sells his product in the nearest market for cash.

With an association such as yours, a business manager or agent may be appointed to control and sell the product of individual members, on lines of a 'co-operative society.'

You have his salary and necessary expenses for printing, advertising, collecting and losses to provide for. How are they to be met? Either by assessing each member at the end of the selling season to cover these expenses and possible losses, or to turn in your product at a price sufficiently low to provide for them. These expenses cannot be arrived at until the season's business has been completed. You have no assured certainty as to what your crop may return you. I have known many co-operative organizations which have been formed for buying and selling. They have invariably ended in disappointment and loss, more especially to those who provided the investment.

It has been demonstrated to you that one must be educated to the ways in growing and by application gain the experience for producing high class products. The selling and distributing of these products likewise require a special education and training, together with experience, and where these requisites are wanting failure is sure to follow.

The seedsman is the natural source through which seed requirements are chiefly supplied. He is educated and equipped for placing before buyers and users any class of seeds, and with his wide connection and business standing over the Dominion, should be better qualified to distribute your product than any other medium.

It requires many years of faithful application and honourable dealings for a seedsman to establish a favourable business reputation, and having secured the confidence of the people, he should be in the best position to aid you.

I would not suggest or recommend you to confine the handling of your product to any single seed house, and while I only offer the suggestion for your consideration, arrangements might be profitably made by your Association with two or three of the largest seed houses, and more particularly with those who supply large quantities of seed grain. Through such medium large quantities might be sold annually, thus aiding you materially, and placing within the reach of every user a quality of seed stock that is much needed for the betterment of agriculture everywhere.

In conclusion, may I impress upon every grower of seeds for farm use the necessity of selecting clean, well enriched soil, that the product may not only be free from noxious weeds, but that the samples may be as perfect as the season for growing will produce, and in this respect I may add that samples will differ in appearance and commercial value in any and every year. The finest sample will undoubtedly meet with most ready sale, and bring the highest prices. No grower should become discouraged if from unfavourable conditions his crop turned out to be inferior and unsuitable in appearance for use as seed. He may meet with this unfavourable experience occasionally; it is one of the ungovernable laws of nature.

It is my earnest belief that the system you are applying for improving cereal stocks will extend in its operations, and that it will give such increased revenue to the users that what may appear a limited market at present will eventually require vast quantities of seed to supply the yearly demand.

The CHAIRMAN.—May I ask Mr. Briggs if he sees any advantage, or any disadvantage, from these certificates of registration passing through the seedsmen's hands and being sent out from them to their customers. Would that add to the value of the grain?

Mr. BRIGGS.—I think it would be of great advantage when the seedsmen were buying the grain that these certificates of registration would accompany the seed, for the reason that it places the seedsmen in a position to look to the source of supply in the event of anything going wrong. And I might add one or two observations here. In my judgment, there should be a committee appointed to take up the matter and estab-

lish a retail selling price at which these various styles of seed should be sold; make it as reasonable as it is thought wise. Then, if the seed is disposed of at shipping houses, a price could be agreed upon, possibly between the grower and the seed house for that particular stock, but the established price should rule as far as possible uniformly. In that way every grower would have an equal advantage.

Mr. SMITH.—Have you any objection to say what the difference should be between the retail price and the price the grower should receive?

Mr. BRIGGS.—I think if the board thought wise to co-operate with the seed house they could meet and talk it over and find at how close a margin the seed could be turned over. The seedsman cannot afford to handle any class of goods unless he gets something for his expenses and a little for the risk. He carries a heavy risk besides the expense of handling. It costs from 20 to 25 per cent on the cost of the original stock to run a seed business. That, of course, is made up very largely in help. Besides, the seedsman has expensive premises, expensive machinery, much advertising, and his catalogue. It amounts to a very heavy item during the season, and while he is issuing these catalogues it would be absolutely necessary for the seedsman to know what he was going to handle on or before the first of November, so that he could put it in his catalogue with any explanation or description that is necessary.

Mr. SMITH.—I do not like to give an opinion without more consideration, but I have given some consideration to this matter, and I am satisfied that no individual seed grower can afford to place his own production on the open market for as low a cost as that which Mr. Briggs has stated. I believe that on a basis of that kind it would be much cheaper, and that the seed grower would get better results, to sell in the manner suggested than by selling himself. I think it is most important, too, that there should be a retail price fixed by this Association at which these goods should be sold. The average farmer—and farmers present will excuse me for saying so—is loath to pay the full price for such an article.

Mr. KIRKHAM.—I estimated the extra cost of this work, and I came to the conclusion that it was worth about 10 cents a bushel to keep it true to variety. It could not be done under 10 cents a bushel.

Mr. BRIGGS.—I think 10 cents a bushel over the market value is a reasonable rate at which to sell the goods.

Mr. MOONEY.—It seems to me the producer does not credit himself with the improvement in his crop from the better seed. He wants to get that extra price for his labour, but he is already fully repaid by the improvement in his crop.

The CHAIRMAN.—I quite concur in the suggestion that there should be a minimum price above the market rate for the ordinary grain that is sold; but I would hope that A's improved registered seed of the 10th year would mean something more to A than B's improved registered seed of the 10th year, if B did not do his selection nearly so well.

METHODS OF GIVING PUBLICITY TO THE PROCEEDINGS AND ACHIEVEMENTS OF THE SEED GROWERS' ASSOCIATION.

(By WM. THOMPSON, *London, Ont.*)

Upon a recent occasion objection was raised in the Canadian Senate that the newspaper press was not paying sufficient attention to the deliberations of that body. One of the leading journals of the country retorted that in proportion as the sayings and doings of the Senate were of vital interest to the people, would the journalists on parliament hill be found gravitating for news to the Red Chamber. At the exhibitions

we invariably find people thronging where something is being done. The bee instinctively turns to those plants in which nectar is distilled. From these homely illustrations may we not fairly draw the moral that primarily and fundamentally this Association, as an educational organization, must make its transactions of vital value to the farmer, and then facilitate its relations with the agricultural journalism of the country. In proportion as its sayings and doings are useful to agriculture will the press be attracted to its deliberations.

As laid down in the constitution, its avowed purpose is the production and general use of improved seed for farm crops. Toward that end meetings like the present are held in order to accumulate and diffuse the results of the experience of successful grain growers and seedsmen, and of the investigations of those eminent men who have made plant improvement their life work. Of such gatherings the alert officers of the Association will:

1st. Keep the press well advised in advance, and specifically invited to be present in order to record and publish the proceedings;

2nd. Provision should be made for the issue, as promtply and attractively as may be, of an annual report, giving in extenso the papers and discussions, and such other data of this and other association meetings as will be of service, and which should be officially preserved for the benefit of members and others;

3rd. From time to time during the year information of an emergent, educational character may be issued through the press and otherwise, relating to seed selection, the treatment of seed or crops for insect and fungoid pests or the eradication of weeds;

4th. The seedsmen of the country might very well be requested to make use of some of the facts in connection with seed improvement in their announcements or advertisements when offering for sale improved or 'pedigreed' seed grown by members of the Association;

5th. More general attention might be paid to seed fairs, the making of displays of improved seed grown by members of the Association at the regular exhibitions, the offering of special prizes for instructively labelled exhibits and descriptions of the pro cess of improved seed growing, and providing competitions in seed grain judging for farmers' sons;

6th. Members of this Association wherever farmers' institutes exist should see that seed improvement is kept to the front by local speakers, and that the superintendents of institutes provide on their delegations speakers who can specialize on these subjects;

7th. As growers begin to produce improved seed, the valuable qualities of which become recognized and fixed in type, and in sufficient quantities to warrant them in so doing, it will naturally be advertised in the press, and in some cases on placards at the main entrance to the farms, the cleanness and general appearance of which will serve as a guarantee of the excellence of the particular seed which may there be obtained. Whether disposed of direct to individual farmers or on the co-operative plan now under trial in several localities, or through some of the well established and reputable seed houses of the country, as the good judgment and experience of those directly concerned may indicate, in any case promptness in the acknowledgment of inquiries and of cash, and in filling orders exactly as per representation made and in accordance with the provisions of the new Seed Bill, will all facilitate the building up of a permanent and satisfactory business. The seed should, of course, be disposed of at such prices as will yield the grower a fair profit for his intelligent effort and enterprise.

Mr. W. L. SMITH.—If I had been charged with the preparation of this question I think I would have put it in a somewhat different form. I say, that the question before us is really how to impress the average farmer of this country with the necessity and importance of using the very best quality of seed. It seems to me that possibly this Association has placed too much emphasis on how to produce the best seed. I think that the very first thing we propose to do is to impress the farmers of this country with the fact that they may add very largely to their crops by the use of the best seed. On one occasion the Hon. Mr. Dwight said: 'If you once give the farmer the idea that he can add very much to the proceeds of his farm, he will at once try to find out how the

increase can be made.' But the first thing is to impress upon him the fact that he can add very largely to the proceeds of his farm by intelligent methods. It seems to me, further, as a means of impressing them, that the charts which Mr. Zavitz has presented this afternoon will be very useful. They show the results not only on the Experimental Farm but on those plots on 4,000 farms all over Ontario. If you show how much more these 4,000 special farms have produced from these plots, you will convince the farmers that they can increase their yield greatly. How are you going to present that fact to them? Speaking from an Ontario standpoint, I would say the very best advertising means you have is found at the winter fair at Guelph. I suggest that you have, at the next winter fair, an exhibit prepared by this Association, not off in one corner, but occupying a most prominent place in the building, an exhibit showing the returns from poor seed and the returns from good seed. Then everybody who goes there may see, through the eye, just how much he can gain, on his own farm, by using the best qualities of seed. I urge, in addition to that, that you make arrangements with the management to have one session, not at the tail end, but at the beginning or the middle, or in the most prominent part of the programme, given up to seed improvement and what it means to the farmers of the country. Mr. Thompson suggests that this matter be brought before the attention of the farmers' institutes; I think that is a capital idea. The superintendent is always looking for some means by which the usefulness of the farmers' institutes may be increased, and I think you can arrange with him to make seed improvement one of the main subjects to be laid before the Farmers' Institute Commission. The farmers' institute is one of the best means to advertise these things. About a dozen of farmers' institutes hold a seed institute meeting every March, and have their exhibits of the best seed. They endeavour to convince the farmer before he commences seeding to have the very best quality of seeds. I think it would be well to have some institute meetings when the crop is actually growing, and o have them on the farms of some of the men who are growing seed through the Association. Let the farmers go and see how much improvement is being made in the seed in that way. Mr. Thompson referred to the necessity of making use of the press. I think the members of the Association can do a great deal for themselves and a great deal for the country by making use of the local newspapers. If every member engaged in the production of seed would go to the man publishing the local newspaper, he would find this man glad to give information for the benefit of farmers all around, showing how much improvement one man has made. But in addition to that, he should make more use of the agricultural press. Mr. Clark has done a great deal in sending matter to the agricultural papers, but there is one objection, and that is, that the same is sent to all papers. I think it would be better to give something fresh to each one. But after all, the main thing the Association has to do is to bring home to every farmer in the province the fact that he can in the course of three years do what Mr. Innes has done—increase his yield by thirty per cent.

Mr. DAVIDSON.—I have been engaged in seed selection for twelve years, and with reference to the cost of producing good true seed, I may say that considerable patience is required, but when a farmer has succeeded in producing good seed and putting his farm in a condition to raise pure seed. I think he will be able to compete in the general market with the rest of the grain because the increase of his crop will give him an advantage.

Mr. WHEATON.—I do not think I can add very much to what has already been said. Mr. Smith has emphasized one point which I had in view, and it is a most important point: that is, educating the farmer to see the necessity of using only good seed. The press, both the local press and the agricultural press, is to my mind a most important medium. Perhaps you could get a lot of good live matter by publishing in as brief a form as possible the experience and results of the members of this Association who have worked up to the present time. I would not go into details about how he selected his plot or anything of that kind, but a little paragraph or two, showing that he grew a certain area of seed, and the second year it increased so much, and so on, showing

the increase from year to year. If a lot of statistics of that kind could be gathered, and sent out to the papers in the country, I think it would be good material. I think if one farmer reads of another farmer in the next township or county who had selected seed and obtained certain results, that would interest him more, in the work of the Association and the value of good seed, than a long treatise on the principles of seed selection. Then, the man who is selecting seed in any locality should do something to attract his neighbour's attention. I think, if I mistake not, Mr. Thompson suggested a placard on the farmer's gate, a bulletin board, so to speak. Perhaps some uniform bulletin board could be designed for a small amount. Have statistics placed on it, and the board fastened to the gate of the man doing the work. We will have to adopt several means, and perhaps it might be possible to make a special feature of one matter one year and the next year take up some other special feature, and thus keep things going all the time.

Dr. FLETCHER.—I appreciate highly the honour my friend Dr. Robertson has done me in asking me to speak before this Association for a few minutes to-day, and I have chosen for my subject what I believe to be one of the foundation principles of your Association, viz., Co-operation. The Seed Growers' Association came into existence to meet a demand for better seed, and therefore for better crops for the whole country. The marked success of this present convention is a proof that such a movement was necessary. I am fully under the impression that the work of this Association will be advanced by a consideration of some collateral subjects which at first sight might not be recognized as important factors of the work of the members. I refer to improved agricultural methods in growing crops, not only the careful selection and improvement of seed by breeding and intensifying certain desirable qualities and accidental variations of well known varieties, but also a dissemination of knowledge which will teach the best way to grow crop plants that are vigorous, hardy, early, prolific and of the very best quality for the various purposes for which they are required. The main objects of this Association, I take it, are to find out how to produce large crops of the very highest quality.

I was not thinking, Mr. Chairman, of speaking to-day of weeds and their control, but more perhaps of the advantage of co-operation between those who are trying to produce high class seed and those specialists who devote their energies towards finding out the best methods of controlling the many insect and fungous enemies which every year levy such a heavy tax upon all who grow farm crops. I cannot help feeling that I might be of some service to the members of this Association in my official capacity as entomologist and botanist to the Government Experimental Farms. Even with the very best of seed, good soil and the most advantageous weather conditions, added to great skill on the part of the cultivator, it frequently happens that there may be a partial or even a complete failure in a crop, owing to the sudden appearance of some parasitic enemy, either an insect or a fungous disease, which had not been calculated upon. For these enemies it cannot be denied are not taken into consideration quite as much as they ought to be, even by the best of our farmers.

There are every year, in some parts of the country, outbreaks of special pests, which very much reduce the profits of farming. Many of these enemies have already been studied, and information is already available by which a large proportion of them may be controlled; or, at any rate, with almost every insect likely to occur upon crops, information may be given at once, on application to specialists, by which much loss may be obviated, by the prompt application of simple and practical remedies. Instances of this kind occur every season. Farmers have learnt in a general way how to treat the regularly occurring crop enemies, and as a general thing, although this is not always the case, have enterprise enough to adopt suggestions made by those who have devoted much time and study to working out the best remedies. Occasionally, serious outbreaks occur of new or unusual enemies, and for lack of information much valuable time is lost or whole crops may be destroyed. Only to-day I have heard of considerable loss having occurred in the corn crop in certain districts around Montreal from an insect which very rarely attacks corn fields, but which is a rather serious occasional enemy to corn

and some other crops in the United States. It was thought at first when the corn plants came up very irregularly through the fields that this was due to poor seed. In some investigations made by the Seed Division last autumn it was found by Mr. Newman that much of the seed corn, grown in the districts from which our Canadian supply is generally procured, had been injured by early autumn frosts. A useful warning was issued by the Division to that effect, and farmers were advised to test their seed for vitality before sowing. Rather naturally, therefore, some of the farmers in the Montreal district referred to, supposed that the failure of the corn to germinate was due to the seed being of low quality, and it is just possible that this may have had something to do with the matter. Some of those who have learnt to use their eyes as well as their brains at the same time, discovered that the seeds in the ground were being destroyed by a white root-maggot, either before the seed germinated or immediately afterwards. This is the larva of a small fly known as the Seed-corn maggot. The perfect fly of this maggot is very similar to that of the root maggots of the radish and onion, and to the ordinary observer looks very much like a rather small house fly. This is a European insect which has a wide distribution not only in Canada but through the United States. Its food habits are rather remarkable. The injuries are practically confined to seeds and young sprouting plants, particularly Indian corn and beans. Pease are occasionally attacked, as well as beets, turnips and radishes. It is probable that the natural food of the larvæ is decaying vegetation, or vegetation which is in an unhealthy condition, and they sometimes even feed on animal matter, for they have been reared from galls on poplar, where they were feeding on plant lice, and Dr. Riley bred specimens from the egg pods of locusts.

The exact life history of this insect is not perfectly known, but the general opinion of those who have studied it, is that it is attracted to fields of corn when something has injured the seed and it is in a decaying condition. It has also been suggested that the flies may be attracted by fresh manure. At any rate, the eggs are laid by the perfect flies in spring, and it is doubtful whether treatment of the seed with any poisonous substance would have any effect in reducing the injury. It is probable that a more satisfactory method of overcoming the injury would be to plough up infested land if the state of the crops warranted this and resow as soon as weather conditions were favourable for corn, and then help the crop with a dressing of nitrate of soda or some other quick-acting fertilizer. In almost every instance where I have myself seen injury from this fly it has been to corn sown in a wet unfavourable period, or when it has been too cold for the seed to germinate freely. Beans or pease sown too deeply will frequently suffer, so that it would appear that seed sown in favourable season and at proper depth, so that it germinated quickly, is seldom injured by this insect.

It is a general principle that plants which are not vigorous, are more liable to attack than those in a healthy condition. Farmers are so imbued with the importance of seeding early that they sometimes overlook that equally important factor of success, of sowing under suitable weather conditions. There are actually crops which I could show you at Ottawa which were sown in the middle of June, which look far better today and are in a better condition than those planted during the dry and cold weather which we had this year in the month of May. Seed sown in the middle of June had moist warm weather, germinated quickly, and has been growing well ever since.

All of these facts, it seems to me, are worthy of consideration by your members, and become integral parts in the success of your efforts to obtain seed of high quality and permanent excellence. There are many branches of the science of agriculture, and no one making a specialty of any single branch can afford to be without at least a working knowledge of the others. The government of that progressive Union to the south of us never begrudges large, even enormous, sums of money if anything for the public good can be obtained, and were I an American citizen (as the people of the United States call themselves), there is no one thing of which I should be so proud as the progressive and wise policy which for many years has been adopted for the advancement of agricultural interests. In the United States Bureau of Entomology, Dr. Howard and his staff have been working away quietly for years, saving millions of dol-

lars for the country, and the same may be said of the Division of Botany. We are fortunate in having with us at this convention Dr. Webber, of the United States botanical staff, and he has told us that he, as a botanist, is working together with the entomologists towards one idea, to develop by scientific breeding and selection a race of cotton which will mature earlier than those now usually grown, and thus avoid injury by the Boll-worm. Similar methods of early and late sowing, catch crops, and trap crops sown between the regular seasons, are devices by which the scientific experimenter endeavours to counteract the injuries of the many enemies which reduce the profits of his labours. By the general adoption of late sowing of fall wheat three years ago the serious outbreak of the Hessian fly was to a large measure controlled. By what is considered late sowing of turnips, we have one of the best methods of preventing injury by the Turnip Flea Beetle. Turnips sown at the end of May are generally swept off from the seed leaves being devoured, while the farmer who waits until the middle of June delays his seeding until the first brood of beetles has disappeared. His plants come up quickly, and have made their rough leaves before the new brood of the year appears in the beginning of July. At that time turnips grow so quickly and there is so much other vegetation to draw off the attack that the turnips make more foliage every day than the beetles are able to destroy. The active remedies, such as dusting the young plants with Paris green and land plaster, may occasionally have to be resorted to, but, as a general thing, turnips sown in the middle of June do not require this.

Again, the best remedy for the clover seed midge, which for the last twenty-five years in Canada has cost the country anywhere from half a million to a million dollars every year, is an agricultural one. This destructive enemy of the seed grower is one which can be easily controlled, and ought to be controlled far better than it is by the seed growers of the country. The remedy has been published over and over again, and is very simple. The first brood of the season lays its eggs in the clover heads as soon as these form. By the time the clover is ready for cutting in ordinary years, the larvæ are mature, and leave the clover to pass their next stage in the ground. These again emerge just as the second crop of clover is forming its flower heads, and the same operation is repeated. It is well known that, if clover be fed off up to the 20th June, or is mowed at that time, that the whole of the first brood is destroyed, and consequently there are no females to lay eggs to destroy the second crop. If all growers of clover seed would adopt this method the numbers of the Clover-seed Midge which every year does so much harm would be materially reduced, a benefit which would keep on increasing year by year.

I will just briefly refer to the Pea Weevil, an insect which annually destroys so much of one of our most valuable crops. Certain circumstances in the life history of this insect enable us to say that if everybody would adopt the recommended remedy of fumigating their seed pease with bisulphide of carbon directly after harvest, and would steadfastly refuse to buy from seedsmen any seed which had not been treated, this insect could in a very few years be entirely wiped out. I recommend this particularly to you all as an Association of which the chief aim is the production of seed of the very highest quality. Seed pease which have been attacked by the weevil are reduced from one-sixth to one-quarter of their value for feed, and almost five-sixths of their value for seed purposes. The details of this attack and the way to remedy it are given at some length in the annual reports of the Division of Entomology of the Experimental Farms. The remedy of fumigating the seed with bisulphide of carbon is, as is generally known amongst those most concerned, the remedy for preventing injury by the Clover-seed Midge. Unfortunately, however, not nearly as many make use of it as ought to do so. There is, I believe, great need of co-operation between you as expert seed breeders and those who study insects and plants in all their bearings. Many crops are destroyed by insects, fungous diseases and noxious weeds which might be simply treated, and much bigger yields secured by the individual farmer, to the great advantage of the country at large. Through the Experimental Farms, Agricultural Colleges and Farmers' Institutes, the people of the country are learning the

underlying principles which govern the growing, the improvement and the breeding of crop-plants, and, as Mr. Grisdale pointed out in his paper yesterday, the same principles apply to all life whether animal or vegetable. It would be well for our farmers and fruit-growers if they knew definitely that it was impossible for any plant to bear seed unless the male and female organs were there, and that these must be brought together for the seed to be fertilized; but many of them do not even know that there are male and female organs in plants. There is much room for the seed grower to teach, and even himself to learn, and the point I wish to make is that no matter how well you do your work you will probably lose something year by year from the attacks of pests. In developing some particular character we are apt to lose some of the constitution of the plant, and there will always be a tendency for a highly developed production to run back to the wild type. As an instance, a weed in some parts of our country is the wild carrot. This is merely the cultivated carrot that has escaped from cultivation and become wild. After about three generations the root will be reduced to little more than the size of one's finger, but to bring this carrot back again to the succulent fleshy root demanded by the horticulturist, it would take many generations of careful selection and breeding. Plants, the same as animals, have their own individuality, as can easily be seen by growing several plants from seeds all taken out of a single pod. You, as breeders of plants, all know this, and take advantage of this tendency to vary, but you must remember that by every degree you get away from the original nature of a plant you run the danger of weakening its constitution, and thus making it subject to the attacks of some of its enemies. It is in this direction that it seems to me I may possibly be of use to the members of this Association, or rather that they may derive useful information from biologists who make a special study of the conditions and facts connected with the development of plants and animals. I can only assure you that I, as an entomologist and botanist, have the keenest sympathy with your Association, and, as one who has taken a keen interest in hybridizing and breeding plants for my whole lifetime, I appreciate the value of your work most thoroughly, and I can only assure you that, the more use I find that I can be to your Association or similar associations, the happier I shall be.

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PART III.